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PRIPRAVA STABILNE SUSPENZIJE ZA LIJEVANJE KOMPOZITNE KERAMIKE

PREPARATION OF STABLE SUSPENSIONS FOR SLIP CASTING OF COMPOSITE CERAMICS

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Stručni članak/ Professional paper

Sažetak: U radu je prikazan utjecaj polielektrolita DOLAPIX CE64, kao disperzanta, na reološke parametre visoko koncentrirane Al_2O_3t-ZrO_2 vodene suspenzije. Pripravljene su 80%-tne Al_2O_3t-ZrO_2 vodene suspenzije s različitim sadržajem DOLAPIX CE64. Omjer Al_2O_3 i t-ZrO_2 u smjesi Al_2O_3t-ZrO_2 je 95:5. Stabilnost suspenzije praćena je mjerenjem zeta potencijala pri različitoj pH-vrijednosti, snimanjem reoloških dijagrama te određivanjem reoloških parametara. Zeta potencijal svih priređenih suspenzija uz dodatak disperzanta poprima vrijednosti veće od +20 mV pri pH-vrijednostima ispod 6, dok vrijednost zeta potencijala svih priređenih suspenzija uz dodatak disperzanta iznose manje od -20 mV pri pH-vrijednostima iznad 9. Bez dodatka disperzanta suspenzije su nestabilne. Reološki dijagrami pokazuju da se promatrane suspenzije ponašaju pseudoplastično. Za procjenu eksperimentalnih podataka uspješno su primijenjeni Potencijski model, Binghamov plastični model te Herschel-Bulkleyjev model. Rezultati mjerenja zeta potencijala i reoloških svojstava 80%-tnih Al_2O_3t-ZrO_2 vodenih suspenzija pokazuju da je DOLAPIX CE64 dobar i učinkovit disperzant.

Ključne riječi: *Al_2O_3t-ZrO_2 suspenzije, reološki parametri, zeta potencijal*

Abstract: In this paper, the effect of commercial polyelectrolyte DOLAPIX CE64, as dispersant, on rheological behavior of 80 wt.% Al_2O_3t-ZrO_2 aqueous suspension is investigated. Highly concentrated aqueous suspensions with different amounts of DOLAPIX CE64 were prepared. The ratio Al_2O_3 and t-ZrO_2 in the mixture of Al_2O_3t-ZrO_2 is 95:5. The stability of prepared suspensions was monitored by measuring the zeta-potential at different pH values and determination of rheological properties (flow curves and rheological parameters). The values of the zeta-potential of suspensions prepared with the addition of dispersant were greater than +20 mV at pH values below 6, while the zeta potential of suspensions prepared with the addition of dispersant reached values less than -20 mV at pH values above the 9. Suspensions without addition dispersant were unstable. Rheological measurements showed pseudoplastic behavior of observed Al_2O_3t-ZrO_2 suspensions. Power low, Bingham plastics and Herschel-Bulkley models have been successfully applied for the evaluation of experimental data. Results of zeta potential measurements and rheological parameters of prepared suspensions indicated that DOLAPIX CE64 is a great and efficient dispersant for high concentrated Al_2O_3t-ZrO_2 suspensions.

Keywords: *Al_2O_3t-ZrO_2 suspensions, rheological parameters, zeta-potential*

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KARAKTERIZACIJA TERMIČKIH SVOJSTAVA NAPREDNIH TEKSTILNIH MATERIJALA

CHARACTERISATION OF THERMAL PROPERTIES OF ADVANCED TEXTILE MATERIALS

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Izvorni znanstveni rad/Original scientific paper

Sažetak: Poznato je da je gorenje organskih materijala vrlo složen proces koji uključuje veliki broj koraka pri čemu materijal prolazi mnoge stadije raspadanja i oksidacije te nam na taj način omogućuje karakterizaciju različitih materijala s obzirom na djelovanje topline. Na zapaljivost tekstilnih materijala utječu razni faktori kao što su sastav vlakna, građa vlakna, koncentracija kisika i uvjeti okoliša (vlaga, toplina, protok zraka) kao i sve prethodne obrade na ispitivanom materijalu. Kao posljedica složene prirode i loše reproducibilnosti požara postoje mnoge metode za procjenjivanje svojstava zapaljivosti različitih polimernih materijala. U radu će biti prikazani dosadašnji rezultati istraživanja u svrhu karakterizacije termičkih svojstava naprednih polimernih materijala te analiza ekoloških aspekata s obzirom na produkte razgradnje. Za fizikalno-kemijsku karakterizaciju su primijenjene slijedeće metode analize: termogravimetrijska analiza (TGA), TG analiza uz praćenje razgradnih plinova pomoću sučelja koje omogućava mjerenje istih na IR spektrofotometru (TG-IR). Također su proučavana toplinska svojstva na mikrokalorimetru za sagorijevanje (MCC).

***Ključne riječi**: termička svojstva, tekstil, uređaj za sagorijevanje (MCC), termogravimetrijska analiza (TG), FT-IR spektroskopija, TG-IR analiza*

Abstract: It is well known that burning of organic materials is a very complex process, involving a great number of steps wherein the material undergoes successively many stages of disintegration and oxidation thus allowing the characterization of different materials with respect to the heat activity. Textile material flammability is affected by various factors such as fiber composition, fiber construction, oxygen concentration, and the environmental conditions (moisture content, heat, air flow), as well as previous treatment on the material. As consequence of the complex nature and poor reproducibility of fire there are many techniques for estimating the flammability characteristics of various advanced polymeric materials. Former results of research for the purpose of thermal properties characterization and environmental aspects analysis with regard to the decomposition products were investigated in this paper. The following methods of analysis were used for physico-chemical characterization: thermal gravimetric analysis (TG) and coupled TG-IR technique. Thermal properties measured with microscale combustion calorimeter (MCC) were additionally investigated.

***Key words**: thermal properties, textile, microscale combustion calorimeter (MCC), thermal gravimetric analysis (TG), FT-IR spectroscopy, TG-IR analysis*

RHEOLOGY OF POLYMER MODIFIED BITUMEN WITH ETHYLENE VINYL ACETATE

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Izlaganje sa znanstvenog skupa/Conference presentation

Abstract: The bitumen (BIT) acts as a binder for the mineral aggregates which are laid down and compacted to form an asphalt road. The use of bitumen in paving applications has generated a lot of interests in its rheological properties because of their importance in the manufacture and quality of bituminous pavements. Polymeric additives have been widely used to enhance the properties of bitumen. The additions of polymers to obtain polymer modified bitumen dramatically change the rheological properties.

The viscoelastic behavior of the modified bitumens containing semi crystalline copolymer ethylene vinyl acetate, EVA, is presented. The morphology, storage stability and rheological properties of the modified bitumens were studied using fluorescence microscopy, dynamic shear rheometer, DSR, and conventional tests. The rheological properties of BIT and polymer modified bitumens, PMBs, i.e. complex shear modulus (G*), complex viscosity (η*) and phase angle (δ) were measured in the linear viscoelastic range (LVE) and in a broad temperature range at traffic frequency of 10 rad/s. The critical temperature, i.e. resistance on permanent deformation is done according to SHRP (Strategic Highway Research Program). The resistance of BIT and PMBs on permanent deformation was determined from the equation G*/sin δ.
The results indicated that the morphology and rheological properties of the modified bitumens were influenced by content of the added polymer. Polymer modification improved bitumen rheological properties such as increased G*, η* as well as the elastic response. The degree of the improvement generally increased with polymer content. At low polymer contents, the samples showed the existence of dispersed polymer particles in continuous bitumen phases, whereas at high polymer contents a continuous polymer phase is observed. PMBs have higher temperature resistance on permanent deformation under traffic frequencies than BIT, which means better properties in use in road construction.

Keywords: *BIT, EVA, PMB, rheological properties, permanent deformation, fluorescent microscopy, storage stability*

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UTJECAJ BRZINE HLAĐENJA NA RAZVOJ MIKROSTRUKTURE AlSi11Cu2(Fe) LEGURE

INFLUENCE OF THE COOLING RATE ON MICROSTRUCTURE DEVELOPMENT OF AlSi11Cu2(Fe) ALLOY

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Izvorni znanstveni rad/Original scientific paper

Sažetak: U radu je provedeno istraživanje utjecaja brzine hlađenja na slijed skrućivanja AlSi11Cu2(Fe) (EN AC-46100) legure ispitivanjem kemijskog sastava, modeliranjem ravnotežnog faznog dijagrama i metalografskom analizom. Tijekom lijevanja praćene su jednostavna i simultana toplinska analiza taljevina radi uvida u egzaktne temperature faznih transformacija u materijalu tijekom skrućivanja. Dobiveni termodinamički parametri rezultirali su utvrđivanjem slijeda skrućivanja: razvoj dendritne mreže (α_{Al}), visokotemperaturne željezne faze ($Al_x(Fe,Mn)_ySi_z$), eutektičkog silicija ($\alpha_{Al}+\beta_{Si}$), kompleksne intermetalne faze na osnovi bakra i magnezija $Al_xSi_yMg_zCu_w$ isprepletene s eutektičkim silicijem, te posljednje skrućujuće faze na osnovi bakra tipa ternarnog eutektika (Al-Al_2Cu-Si), izlučene po granicama zrna i između lamela ili vlakana eutektičkog silicija. Brzina hlađenja značajno utječe na temperature izdvajanja pojedinih faza i temperaturni interval skrućivanja, kao i morfologiju precipitiranih intermetalnih faza.

Ključne riječi: *Al-Si legura, toplinska analiza, mikrostruktura, slijed skrućivanja*

Abstract: Examination of the influence of cooling rate on solidification sequence of AlSi11Cu2(Fe) (EN AC-46100) alloy was performed by investigation of chemical composition, modelling of equilibrium phase diagram and metallographic analysis. During casting, simple and simultaneous thermal analyses were followed in order to determine the exact temperatures of phase transformations in material during solidification. The obtained thermo-dynamical parameters resulted in determination of solidification sequence: dendrite network development (α_{Al}), high-temperature iron phase ($Al_x(Fe,Mn)_ySi_z$), eutectic silicon ($\alpha_{Al}+\beta_{Si}$), complex intermetallic phase on the copper and magnesium base $Al_xSi_yMg_zCu_w$ interwoven with eutectic silicon and final solidifying phase on the copper base in the form of ternary eutectic (Al-Al_2Cu-Si) precipitated on the grain boundaries and between lamellae or fibres of eutectic silicon. The cooling rate significantly influences the precipitation temperature of particular phases and temperature interval of solidification, as well as morphology of intermetallic phase.

Keywords: *Al-Si alloy, thermal analysis, microstructure, solidification sequence*

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KORISNIČKA SUČELJA U WEB 2.0 OKRUŽENJU

USER INTERFACES IN WEB 2.0 ENVIRONMENT

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Pregledni rad/Subject review

Sažetak: Kroz cijelo razdoblje, od nastanka do danas, Web se postupno transformirao iz statičnog medija u globalnu komunikacijsku platformu. Brisanjem strogih uloga autora i korisnika informacije omogućeno je slobodno stvaranje i razmjena korisnog sadržaja. Opće prihvaćanje novih principa, simbolično nazvanih Web 2.0 modelom, snažno je utjecalo na grafičko i funkcionalno oblikovanje korisničkih sučelja u novom okruženju. Statične HTML stranice počele su se transformirati u interaktivne Web aplikacije, a jednostavnost, upotrebljivost i vizualna atraktivnost prihvaćene su kao temeljne odlike modernih korisničkih sučelja. Potreba za naprednom tehničkom izvedbom ubrzala je razvoj multimedijskih Web tehnologija, a završetak službene specifikacije HTML5 i CSS3 opisnih jezika u bliskoj budućnosti, značajno će unaprijediti postojeće tehnike oblikovanja korisničkih sučelja u Web 2.0 okruženju.

Ključne riječi: *Web 2.0, korisnička sučelja, aplikacije, HTML5, CSS3*

Abstract: Through the whole period, from creation until today, Web has gradually transformed from the static medium to the global communication platform. Deletion of strict roles of information authors and users, enabled free creation and sharing of useful content. General acceptance of new principles, symbolically called the Web 2.0 model, had a strong influence on the graphical and functional designing of user interfaces in a new environment. At that point, statical HTML pages started to be transformed into the interactive Web applications. Attributes such as simplicity, usability and visual appeal were accepted as fundamental characteristics of modern user interfaces. The need for advanced technical performace accelerated the development of multimedia Web technologies. Completion of official specification of HTML5 and CSS3 markup languages in the near future will significantly improve the existing techniques of user interface design in Web 2.0 environment.

Keywords: *Web 2.0, user interfaces, applications, HTML5, CSS3*

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UTJECAJ BRZINE HLAĐENJA NA MEHANIČKA I MIKROSTRUKTURNA SVOJSTVA POLUKONTINUIRANO LIJEVANOG Al-Mg BLOKA

INFLUENCE OF COOLING RATE ON THE MECHANICAL AND MICROSTRUCTURE PROPERTIES OF SEMICONTINUOUS CAST Al-Mg SLAB

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Izvorni znanstveni rad/Original scientific paper

Sažetak: U okviru ovog rada određivan je utjecaj brzine hlađenja bloka (ovisno o mjestima uzimanja uzoraka) aluminijske slitine EN AW-5083, lijevanog polukontinuiranim, vertikalnim postupkom izravnim hlađenjem vodom (VDC- postupkom) na broj zrna po jedinici ispitivane površine, tvrdoću i vlačna svojstva. Ispitivanja su provedena u cilju ocjene djelovanja uvjeta lijevanja i učinkovitosti cijepljenja na postizanje finozrnate, istoosne i ujednačene mikrostrukture, kao osnovnog preduvjeta efikasne naknade obrade i kvalitetnog konačnog proizvoda. Ustanovljeno je da postoji korelacija između promjene broja zrna po jedinici površine i izmjerenih vrijednosti tvrdoće, te da je osim uske rubne zone dobivena jednolika veličina zrna i tvrdoća po presjeku bloka, bez izražene zone štapićastih ili pojave „perjastih“ kristala. Vrijednosti vlačne čvrstoće i istezanja pokazuju trend povišenja uz rubove ploča, odnosno prate promjenu mikrostrukture tj. broja zrna po jedinici površine. Vrijednosti granice razvlačenja nemaju karakterističan trend ponašanja. Dobiveni rezultati ukazuju na korektne parametre lijevanja i cijepljenja taljevine.

Ključne riječi: *slitina EN AW-5083, brzina hlađenja, broj zrna po jedinici površine, tvrdoća, vlačna svojstva*

Abstract: Within this work the effect of cooling rate (depending on the locations of sampling) of aluminium slab of EN AW-5083 alloy cast by semi-continuous, vertical process with the direct water cooling (VDC process) on the number of grains per unit area, hardness and tensile properties has been determined. Examinations were conducted with the aim of estimation of the casting conditions influence and the inoculation efficiency on the fine, equiaxial and uniform microstructure as the main prerequisite for the efficient later treatment and qualitative final product.The correlation between the change of the number of grains per unit area and the measured hardness values has been established, and apart from the tight edge zone the uniform grain size and hardness through the ingot section were obtained, without pronounced columnar zone or the appearance of the “feather” crystals. The values of tensile strength and elongation have shown a trend of increase along the edges of the plate, or follow the change of microstructure, i.e. the number of grains per unit area. Values of yield strength have no distinctive trend behavior. The obtained results point out the concrete casting parameters or the melt inoculation.

Keywords: *EN AW-5083 alloy, grain size, number of grains per unit area, hardness, tensile properties*

POSSIBILITIES OF X-RAY MICROTOMOGRAPHY FOR NON-DESTRUCTIVE TESTING OF MATERIALS

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Izvorni znanstveni rad/Original scientific paper

Abstract: X-ray microtomography is a technique suitable for nondestructive characterization of materials. This method is sufficient for visualizing of interior features within the solid objects and for obtaining digital information focused on 3-D geometries and properties. For example - observation of inclusions, voids, defects, exact measurement of inner dimensions, etc.

X-ray microtomography is useful for a wide range of materials such as metals, ceramics, plastic, biological materials and their combinations. This paper is focused on describing the possibility of using the technique in the field of material research.

Keywords: *X-ray, microtomography, nondestructive characterization*

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ISTRAŽIVANJE UTJECAJA STUPNJA DEFORMACIJE I POČETNE TVRDOĆE NA KONAČNU TVRDOĆU RADNIH PREDMETA KOD VIŠESTUPANJSKOG IZVLAČENJA

INVESTIGATION OF THE INFLUENCE OF THE DEGREE OF STRAIN AND THE INITIAL HARDNESS ON THE FINAL HARDNESS OF WORKPIECES IN MULTI-STAGE DRAWING

Himzo Đukić[1], Mirna Nožić[2], Eldar Čolaković
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Prethodno priopćenje/Preliminary note

Sažetak: U radu su dati rezultati eksperimentalnih istraživanja utjecaja stupnja deformacije i početne tvrdoće na konačnu tvrdoću radnih predmeta izrađenih izvlačenjem s redukcijom debljine zida. Materijal radnih predmeta je CuZn28 sa različitom početnom tvrdoćom.
Predmeti su izvlačeni u prvoj operaciji na prstenu s traktrix krivom, u drugoj i trećoj operaciji na alatima s dva prstena, a u četvrtoj operaciji na alatu s tri prstena.
Matematički modeli se s velikom točnošću slažu s eksperimentalnim vrijednostima izmjerenih tvrdoća nakon svake operacije izvlačenja.

Ključne riječi: *tvrdoća, logaritamska deformacija, višestupanjsko izvlačenje*

Abstract: The paper presents the results of experimental investigations of the deformation degree influence and the influence of initial hardness on the final hardness of workpieces made by drawing with the reduction of wall thickness. The workpieces material is CuZn28 with different initial hardness.
The objects are drawn in the first operation on a ring with traktrix curve, in the second and third operation on tools with two rings, while the fourth operation on the tool with three rings.
Mathematical models with great accuracy agree with the experimental values of hardness measured after each drawing operation.

Keywords: *hardness, logarithmic strain, multi-stage drawing*

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MICROSTRUCTURE OF CuAlNi SHAPE MEMORY ALLOY AFTER CONTINUOUS CASTING

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Prethodno priopćenje/Preliminary note

Abstract: In this work the microstructure analysis of CuAlNi shape memory alloy was performed. For the production of Cu-Al-Ni shape memory alloy the continuous casting technique directly from the melt was used. By this technique a bar with 8mm diameter was manufactured. The microstructure characterization of cast bar was carried out after solidification by optic microscopy (OM) and scanning electron microscopy (SEM), respectively. The martensite phase primary as the needle-like into grains was observed. Martensite laths have different orientations into particular grains. It was found that average grain size was 98.78μm. The grain diameter near the external surface is higher than in the center.

Keywords: *shape memory alloys, martensite, continuous casting, grain size*

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REPRODUCIBILITY OF ENERGY ABSORPTION EFFICIENCY OF ALUMINIUM FOAMS

PONOVLJIVOST ISKORISTIVOSTI APSORBIRANJA ENERGIJE ALUMINIJSKIH PJENA

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Izvorni znanstveni rad/Original scientific paper

Sažetak: Aluminijska pjena je u osnovi kompozitni materijal koji se sastoji od aluminijske osnove ili osnove od neke aluminijske legure i pora ispunjenih plinom. Ovaj rad istražuje ponovljivost rezultata ispitivanja iskoristivosti apsorpcije energije aluminijske pjene. Uzorci aluminijske pjene proizvedeni su iz "Alulight" prekursora (AlMgSi 0.6 TiH_2-0.4). Prekursor je stavljen u kalup i zagrijavan sve dok se plinski agens nije počeo pjeniti. Nakon toga je kalup izvađen iz peći i hlađen pri čemu je uzorak pjene poprimio oblik kalupa. Iskoristivost apsorpcije energije aluminijskih pjena procjenjena je iz rezultata tlačnog ispitivanja koje je provedeno na kidalici. Rezultati ispitivanja pokazali su da aluminijske pjene imaju dobru iskoristivost apsorpcije energije i da je ponovljivost rezultata relativno niska.

Ključne riječi: *aluminijske pjene, iskoristivost apsorpcije energije, tlačno ispitivanje*

Abstract: Aluminium foam is, principally, a composite material consisting of aluminium or aluminium alloy matrix and of pores filled up with a gas distributed throughout the matrix.
This paper studies the reproducibility of aluminium foams energy absorption efficiency. Samples of aluminium foam were produced from an Alulight precursor (AlMgSi0.6 TiH_2-0.4). This precursor was placed into a mould and heated up until the agent started to foam. Immediately thereafter the mould was taken out of the furnace and cooled off, so the aluminium foam part was frozen in shape. The ability of samples to absorb mechanical energy was estimated from the results of compression tests. Tests were carried out by a universal test machine. Test results showed that aluminium foams have good energy absorption efficiency and repeatability is relatively low.

Key words: *aluminium foams, energy absorption efficiency, compression test*

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EROZIJSKO TROŠENJE CIJEVI TOPNIČKIH ORUŽJA

EROSIVE WEAR OF ARTILLERY WEAPONS BARREL

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Izvorni znanstveni rad/Original scientific paper

Sažetak: Prilikom opaljenja, u cijevi topničkog oružja dolazi do vrlo složenih i intenzivnih mehaničkih, toplinskih i kemijskih procesa. Proces opaljenja ima složeno tribološko djelovanje na cijev oružja. On uzrokuje postojanje nekoliko mehanizama trošenja, koji djeluju istodobno, a među njima je i erozija čvrstim česticama. Do erozije dolazi zbog toga što se u barutnim plinovima nalaze čestice čađi i zrnca neizgorjelog baruta, koji su nošeni velikom brzinom snažnim turbulentnim strujanjem vrućih barutnih plinova. Oni udaraju u površinu kanala cijevi i izazivaju njezino erozijsko trošenje.
U ovom radu napravljeno je ispitivanje otpornosti na erozijsko trošenje materijala cijevi. Ispitni uzorci izrađeni su od meko žarenih čelika: C45, 25CrMo4 i 36CrNiMo4. Svi ispitni uzorci su poboljšani. Trećina uzoraka je zatim nitrirana, a trećina tvrdo kromirana. Za svaki materijal i stanje površine uzoraka izvedena su tri mjerenja. Izmjereni gubitak mase uzorka određen je kao kvantitativni pokazatelj otpornosti materijala na erozijsko trošenje. Dobiveni rezultati prikazani su tablično i u obliku dijagrama.

***Ključne riječi*:** trošenje, erozija, krute čestice, cijev, proces opaljenja

Abstract: During the firing process, very complex and intense mechanical, thermal and chemical processes are developed in the artillery weapon barrel. So, the firing process has a compound tribological effect on the weapon barrel. It causes the appearance of many wear mechanisms at the same time, including the solid particles erosion. The erosion occurs because soot particles and unburned powder grains are contained in the powder gases and they move at high speed in the strong turbulent streaming of the hot powder gasses. So those particles hit the bore surface and the erosive wear of the barrel appears.
In this paper, the erosion wear resistance of the barrel materials is tested. The test samples were made of soft annealed steels: C45, 25CrMo4 and 36CrNiMo4. All samples were quenched and tempered. One third of them was subsequently nitrated, and the other third of samples was hard-chrome plated. Three measurements were performed for each material and surface condition of test samples. The measured mass loss of each test sample was determined as a quantitative indicator of the erosion wear resistance of the material. The results are presented in the tables and diagrams.

Key words: *wear, erosion, solid particles, barrel, firing process*

INNOVMAT – KNOWLEDGE TRANSFER PLATFORM IN THE FIELD OF ENGINEERING MATERIALS

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Pregledni rad/Subject review

Abstract: The platform INNOVMAT (www.innovmat.eu) supports innovation activities of industrial enterprises from Central European region by transfer of knowledge acquired by R&D in the field of engineering materials and advanced technologies of their production and processing into industrial practice. The main mission of INNOVMAT is to support the development of industrial products with extremely high added value and to increase competitiveness of industrial enterprises on the world-wide markets by application of newly developed advanced materials and related technologies.

The guide to enhance the effectiveness of cooperation between scientists in identification of new potential industrial applications of engineering materials with the aim to fulfill the needs of regional manufacturing SMEs as well as several case studies of successful cooperation between R&D institutions, universities and industrial enterprises have been outlined in this contribution.

Key words: *engineering materials, advanced technologies, knowledge transfer, regional development, sustainable products, industrial innovations*

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ZAŠTITA ČELIKA OZNAKE AISI 1018 OD KOROZIJE EKSTRAKTOM LISTA MASLINE

CORROSION PROTECTION OF STEEL DESIGNATED AS AISI 1018 BY OLIVE LEAF EXTRACT

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Prethodno priopćenje/Preliminary note

Sažetak: U ovom radu ispitana je tendencija ugljičnog čelika oznake AISI 1018 prema nastanku jamičaste korozije u destiliranoj i sintetskoj slojnoj vodi bez i u prisutnosti ekstrakta lista masline (Olea europaea L.) kao ekološki prihvatljivog korozijskog inhibitora. Ispitane su koncentracije inhibitora 50, 100, 150 i 200 mg/l. Mjerenja su provedena metodom cikličke polarizacije u otvorenom sustavu, pri atmosferskom tlaku i sobnoj temperaturi. Primjenom skenirajućeg elektronskog mikroskopa provedena su ispitivanja različitih stanja površine ugljičnog čelika. Metodom gubitka mase određena je djelotvornost inhibitora te su izrađene adsorpcijske izoterme ekstrakta lista masline koje opisuju njegovo ponašanje na površini ugljičnog čelika AISI 1018.

Ključne riječi: *korozija, ugljični čelik, djelotvornost inhibitora, adsorpcija*

Abstract: In this paper we investigated the tendency of carbon steel designated as AISI 1018 to begin pitting corrosion in distilled water and in the simulated oilfield brine with and without olive leaf extract (Olea europaea L.) as a novel, environmentally acceptable corrosion inhibitor. The inhibitor concentrations of 50, 100, 150 and 200 mg/l were examined. Measurements were conducted using the method of cyclic polarization in an open system at atmospheric pressure and room temperature. Testing of different states of the carbonic steel surface was conducted by scanning electron microscope. Using the mass loss method, the efficiency of the inhibitor was tested and the adsorption isoterms of olive leaf extract, which describe its behavior on the carbon steel surface, were made.

Keywords: *corrosion, carbon steel, efficiency of inhibitor, adsorption*

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UTJECAJ TEMPERATURE I VELIČINE ČESTICE NA DISOCIJACIJU $CaCO_3$

INFLUENCE OF TEMPERATURE AND PARTICLE SIZE ON $CaCO_3$ DISSOCIATION

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Izvorni znanstveni rad/Original scientific paper

Sažetak: U ovom radu je ispitivan utjecaj temperature i veličine čestica na termičku disocijaciju vapnenca. Dobiveni eksperimentalni podaci iskorišteni su za određivanje najsporijeg koraka u procesu disocijacije pri čemu je korišten model jezgre.
Dobiveni rezultati ukazuju da veličina čestice ima značajniji utjecaj na brzinu disocijacije. Prema modelu jezgre na česticama veličine 3.2 mm reakcija se odvija u kinetičkom području (znači sama reakcija je najsporiji korak), na česticama veličine 15 mm najsporiji korak je kondukcija topline kroz nastali produkt, a na česticama veličine 26 mm difuzija nastalog CO_2 kroz kruti produkt.

Ključne riječi: *vapnenac, model jezgre*

Abstract: The influences of temperature and particle size on the thermal lime dissociation were examined. The obtained experimental data are used to identify the slowest on-going process using the shrinking core model.
The obtained results indicate that particle size has a significant impact on the kinetics of dissociation. According to the shrinking core model, for 3.2 mm particles, the reaction is in the kinetic area (the chemical reaction itself is the slowest process). For 15mm particles the slowest process is conduction of the heat through solid product, and for the 26mm particles diffusion of the carbon dioxide through solid product.

Keywords: *lime, shrinking core model*

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SEM KARAKTERIZACIJA NAPREDNIH TEKSTILNIH MATERIJALA

SEM CHARACTERISATION OF ADVANCED TEXTILE MATERIALS

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Izvorni znanstveni rad/Original scientific paper

Sažetak: Razvoj naprednih materijala je imao veliki utjecaj na razvoj tzv. visoke tehnologije. Jedna od takvih tehnologija je i skenirajuća elektronska mikroskopija (SEM). U radu je dan pregled istraživanja provedenih na Tekstilno-tehnološkom fakultetu Sveučilišta u Zagrebu u području karakterizacije naprednih materijala putem SEM-a. U ovaj prikaz je uključena karakterizacija površine različitih prirodnih ili sintetskih materijala različitih oblika i funkcionalnosti, od tradicionalnih vlakana, tkanina, pletiva, netkanih tekstilija, sve do naprednih kompozitnih materijala. Najnoviji razvoj materijala kreće u smjeru održivog razvoja i mogućnosti recikliranja, te je naglasak ovog rada upravo na takvim uzorcima. Raznolikost proizvedenih elektronskih signala nastalih u SEM-u daje različite morfološke, fizikalne i kemijske informacije ispitivanog uzorka. Dodatna analiza korištena u radu je energetski disperzivna spektroskopija – EDS (*Energy Dispersive X-ray Spectroscopy*), koja nam omogućuje određivanje kemijskog sastava ispitivanog uzorka. U današnje vrijeme je SEM jedan od najčešće korištenih instrumenata u području tekstilne znanosti i njegovom primjenom uspješno ulazimo u svijet bio, mikro i nano-tehnologije.

***Ključne riječi**: skenirajuća elektronska mikroskopija (SEM), tekstilni materijali, znanost o materijalima*

Abstract: The development of advanced materials has significant influence on the development of high-tech technology. One of such sophisticated technology is scanning electron microscopy (SEM). The paper gives an overview of research conducted at the University of Zagreb, Faculty of Textile Technology in the field of the characterization of advanced materials by SEM technique. The overview includes the surface characterization of different natural or synthetic materials of various shapes or functionality, all the way from the traditional fibres, fabrics, knitwear, non-woven textiles to the advanced composite materials. Recent development of materials is moving in the direction of sustainable development and recycling, and the emphasis of this paper is on these materials. The variety of produced electron signals incurred in SEM provides different morphological, physical and chemical information of the sample. Additional analysis used in this paper for the characterization is energy dispersive X-ray spectroscopy - EDS, which allows us to determine the chemical composition of the sample. Today, SEM is one of the most commonly used instruments in the field of textile science and by its application the scientists are successfully entering into the world of bio, micro and nano-technology.

***Key words**: scanning electron microscopy (SEM), textile, material science*

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THE ASSESSMENT OF MICROSTRUCTURAL FEATURES OF DUCTILE IRON BY USING THERMAL ANALYSIS

PROCJENA MIKROSTRUKTURNIH ZNAČAJKI NODULARNOG LIJEVA TOPLINSKOM ANALIZOM

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Izvorni znanstveni rad/Original scientific paper

Sažetak: U ovom radu je analiziran utjecaj parametara koji su registrirani i mjereni toplinskom analizom na mikrostrukturne značajke nodularnog lijeva. Ustanovljeno je da broj nodula/mm^2 i nodularnost rastu s povećanjem temperature eutektičnog pothlađenja (T_{EP}) i grafitnog faktora 1 (GRF 1), te smanjenjem rekalescencije (T_R), grafitnog faktora 2 (GRF 2) i vrijednost prve derivacije krivulje hlađenja na solidus temperaturi (d/dt T_S). Dobiveni rezultati pokazuju da udio ferita raste s povećanjem temperature eutektičkog pothlađenja (T_{EP}), grafitnog faktora 1 (GRF1) i temperature eutektoidne pretvorbe (A_1) te se smanjuje s povećanjem rekalescencije (T_R), grafitnog faktora 2 (GRF 2) i vrijednosti prve derivacije krivulje hlađenja na solidus temperaturi (d/dt T_S). Obrada dobivenih rezultata je provedena višestrukom regresijskom analizom. Na osnovi mjerenih toplinskih parametara formirani su modeli za procjenu mikrostrukturnih značajki (broja nodula/mm^2, nodularnosti i udjela ferita). Visoke vrijednosti koeficijenata korelacije između mjerenih i procijenjenih vrijednosti mikrostrukturnih značajki, potvrđuju da postoji čvrsta korelacija između toplinskih parametara taline nodularnog lijeva i mikrostrukturnih značajki odljevaka od nodularnog lijeva.

***Ključne riječi**: nodularni lijev, mikrostruktura, toplinska analiza*

Abstract: The effect of parameters which are identified and measured by thermal analysis on the microstructural features of ductile iron was analyzed in this paper. It was found that the nodule count and nodularity increase with increasing the temperature of eutectic undercooling (T_{EP}) and graphite factor 1 (GRF 1) and decreasing recalescence (T_R), graphite factor 2 (GRF2) and value of the first derivative of the cooling curve at T_S (d/dt T_S). The obtained results show that the ferrite content increases with increasing the temperature of eutectic undercooling (T_{EP}), graphite factor 1 (GRF 1) and temperature of eutectoid transformation (A_1) and decreases with increasing the recalescence (T_R), graphite factor 2 (GRF 2) and value of the first derivative of the cooling curve at T_S (d/dt T_S).The processing of obtained results was performed by multiple regression analysis. Based on the measured thermal parameters, the models for estimation of microstructural features (nodule count, graphite nodularity and ferrite content) were established. High correlation coefficients between the measured and the estimated values of microstructural features confirm that there is a tight correlation between the thermal parameters of ductile iron melt and microstructural features of ductile iron castings.

***Keywords**: ductile iron, microstructure, thermal analysis*

INFLUENCE OF GRAPHITE STRUCTURE ON VOLT-AMPERE CURVE IN GRAPHITE-COPPER SLIDING PAIRS

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Izvorni znanstveni rad/Original scientific paper

Abstract: The physical transport properties of graphite-copper sliding contact systems were examined for volt ampere dependence. The experimental curve was measured on typical, representative graphite materials as turbostratic structure and hexagonal structure, with different crystallite sizes L_a. The shape of volt-ampere curve was analyzed for influence of transport electrons and phonons across the sliding pair.
The results are as follows:

1. The shape of volt-ampere curve depends on the electron and phonon scattering;
2. If the crystallite sizes L_a of graphite are large, the volt ampere curve is nonlinear. On the other hand, if the crystallite sizes L_a are small, the volt ampere curve is near-linear.

The transport properties of graphite-copper contact can affect the electrical part wear of graphite.

***Key words**: graphite, carbon, sliding contact, V-A curve dependence, graphite crystallite*

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KARAKTERIZACIJA SOL-GEL TIO_2 PRAHA IR-SPEKTROSKOPIJOM

CHARACTERIZATION OF SOL-GEL TIO_2 POWDER BY MEANS OF IR-SPECTROSCOPY

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Izvorni znanstveni rad/Originalscientific paper

Sažetak: U ovom radu napravljena je FTIR analiza sol-gel TiO_2 uzoraka nakon toplinske obrade na temperaturi od 100, 150, 200, 250, 300, 350, 450 i 550 °C u području valnih duljina od 4000 cm^{-1} do 600 cm^{-1}. Za pripravu sola kao prekursor korišten je titanov izopropoksid, 2-propanol kao otapalo, uz dodatak nitratne kiseline kao katalizatora, acetilacetona za peptizaciju te organskog aditiva polietilenglikola (PEG-a). FTIR analizom praćen je proces od sušenja gela do kristalizacije TiO_2 praha u temperaturnom području od 100 °C do 550 °C te je utvrđen položaj karakterističnih vrpci. IR-spektri sol-gel TiO_2 međusobno se razlikuju ovisno o temperaturi toplinske obrade. Kod viših temperatura (iznad 250 °C) IR-spektri gube vrpce karakteristične za organske spojeve koji su korišteni za pripravu sola, a nastaju i pojačavaju se vrpce karakteristične za kristalne faze TiO_2.

Ključne riječi: *sol-gel sinteza, TiO_2, Infracrvena spektroskopija s Fourierovom transformacijom (FTIR)*

Abstract: In this paper Fourier transform infrared spectroscopy (FTIR) analysis of sol-gel TiO_2 samples after heat treatment at 100, 150, 200, 250, 300, 350, 450 and 550°C in the wave numbers range of 4000 cm^{-1} to 600 cm^{-1} was made. For the sol preparation the following components were used: titanium isopropoxide as a precursor, 2-propanol as solvent, nitric acid as a catalyst, acetylacetone for peptization and organic additive polyethylene glycol (PEG). Process from drying the gel to the crystallization of TiO_2 powder in the temperature range of 100°C to 550°C was determined by FTIR analysis. IR spectra of sol-gel TiO_2 differ from each other depending on the temperature at which they are treated, at higher temperatures (above 250°C) IR spectra lose their characteristic bands for organic compounds that are used for the preparation of sol, and the resulting amplified bands characteristic for the crystal phases of TiO_2.

Keywords: *sol-gel synthesis, TiO_2, Fourier transform infrared spectroscopy (FTIR)*

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ISPITIVANJE STABILNOSTI Al_2O_3 SUSPENZIJA SEDIMENTACIJSKIM TESTOVIMA

STABILITY OF Al_2O_3 SUSPENSION DETERMINED BY SEDIMENTATION TESTS

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Prethodno priopćenje/Preliminary note

Sažetak: U radu je ispitan utjecaj veziva poli(etilen-glikola) (PEG) i disperzanta Darvan 821A na stabilnost Al_2O_3 vodene suspenzije. Pripravljeno je ukupno sedam vodenih suspenzija s 20% Al_2O_3 praha te različitim sadržajem PEG-a i Darvana 821A. Stabilnost suspenzije ispitana je sedimentacijskim testovima. Od svake suspenzije pripravljeno je deset uzoraka s različitim pH-vrijednostima. Volumen suspenzije mjeren je odmah nakon regulacije pH-vrijednosti te nakon 24 sata. Rezultati sedimentacijskih testova pokazali su da su suspenzije bez dodatka disperzanta nestabilne, dok su sve suspenzije s disperzantom Darvan 821A pokazale zadovoljavajuću stabilnost. PEG je dodan u funkciji veziva te nije pokazao nikakav utjecaj na rezultate sedimentacijskih testova.

Ključne riječi: *aluminij oksidna keramika, stabilnost koloidnih suspenzija, sedimentacijski testovi.*

Abstract: In this paper, the effect of binder poly(ethylene-glycol) (PEG) and dispersant Darvan 821A on the stability of aqueous Al_2O_3 suspensions was investigated. Seven suspensions were prepared, each containing 20 wt. % of alumina powder, as well as different amounts of PEG and Darvan 821A. The stability of prepared suspensions was investigated by sedimentation tests. Ten samples with different pH-values were prepared from each suspension. Volumes of prepared suspensions were measured immediately after the pH-value regulation and then after 24 hours. The results of the sedimentation tests showed that all suspensions without the addition of the dispersant Darvan 821A were unstable, while the ones containing Darvan 821A showed satisfying stability. PEG was added as the binder and did not show any effect on the sedimentation tests results.

Keywords: *alumina ceramics, stability of colloidal suspensions, sedimentation tests*

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NEW METHODS OF UV VARNISHING AND THEIR INFLUENCE ON OPTICAL PROPERTIES OF CARDBOARD PACKAGING

NOVE METODE UV LAKIRANJA I NJIHOV UTJECAJ NA OPTIČKA SVOJSTVA KARTONSKE AMBALAŽE

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Izvorni znanstveni rad/Original scientific paper

Sažetak: Procesom UV lakiranja na otiscima se formira tanki prozirni sloj čiji je sjaj znatno viši od izvorno otisnutog bojila. U ovom radu prikazuje se utjecaj tankog sloja UV laka na sjaj i kromatske vrijednost osnovnih tonskih područja. Diskutira se kako različite metode UV lakiranja mogu utjecati na promjenu obojenja kartonske ambalaže izvorno otisnute u tehnici ofsetnog tiska. Nanos UV laka presudan za kvalitetu reprodukcije. Rezultati istraživanja pokazuju da umjereno povećanje sjaja pozitivno utječe na povećanje kvalitete reprodukcije (gamut), dok preveliki sjaj onemogućava dobru vizualizaciju tonova. Na otiscima sa UV Ink Jet mat lakom smanjuje se gamut reprodukcije, dok kod onih tretiranih sa UV Ink Jet gloss lakom gamut se neznatno povećava. Ofsetno in-line lakiranje (s flekso jedinicom) daje najveći gamut, a samim time i najveću kolornu reprodukciju. Pritom izmjerena vrijednost sjaja otiska ne slijedi kromatske vrijednosti. Akromatski tonovi (crna i tiskovna podloga) imaju najveće kolorne promjene.

Ključne riječi: *UV Ink Jet lakiranje, UV ofsetno lakiranje, sjaj otiska, CIE LAB* ΔE_{00}

Abstract: In the process of UV varnishing a thin transparent layer is formed on prints, the gloss of which is considerably higher than that of the originally printed ink. The influence of the thin layer of UV varnish on gloss and on the chromatic values of the basic tonal areas is presented in this work. How the different methods of UV varnishing can influence the change of the colour of cardboard packaging originally printed in the offset printing technique is discussed. The layer of UV varnish is crucial for the reproduction quality. The investigation results show that the considerable gloss increase positively influences the increase of the reproduction quality (gamut), while too high gloss makes good tone visualization impossible. On prints with UV Inkjet mat varnish the gamut of reproduction decreases, while on the prints treated with the UV Inkjet gloss varnish the gamut slightly increases. Offset in-line varnishing (with the flexo unit) gives the greatest gamut and consequently the greatest color reproduction. The measured value of the print gloss does not follow the chromatic values. Achromatic tones (black and printing substrate) have greatest color changes.

Keywords: *UV Ink Jet varnishing, UV offset varnishing, print gloss, CIE LAB* ΔE_{00}

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ANALIZA TROŠENJA KLIZNOG TRIBO PARA Al_2O_3 /PMMA

TRIBO - COUPLE Al_2O_3 / PMMA SLIDING WEAR ANALYSIS

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Izvorni znanstveni rad/Original scientific paper

Sažetak: Utjecaj mehanizma i uvjeta polimerizacije na tribološka svojstva polimera bit će ispitan na uzorcima poli(metil-metakrilatnih) dentalnih smola – PMMA. Ta se vrsta polimernih smola vrlo često koristi u dentalnoj medicini za razne vrste nadogradnji i dijelova. Za tu namjenu povoljnim ga čine biokompatibilnost, obradljivost te niska razina toksičnosti. Osim u dentalnoj medicini često se koristi i u drugim granama u aplikacijama poput leća, koštanih fiksatora, koštanog cementa, punila za šupljine u kostima i lubanji. U ovom radu opisat će se moguća metoda in vitro ispitivanja interakcije materijala dentalnih udlaga i zubi. Al_2O_3 keramika predložena je u normi kao supstitucijski materijal za materijal zuba. PMMA član opisanog tribosustava variran je s obzirom na mehanizam polimerizacije dok je kao međumedij korištena umjetna slina različitih vrijednosti pH faktora. Ispitivanja su provedena na uređaju koji omogućuje trošenje tijekom pravocrtnog gibanja.

Ključne riječi: *trošenje, PMMA, Al_2O_3,*

Abstract: Influence of polymerization mechanisms and conditions on tribological properties of PMMA dental resins is investigated in this paper. This type of polymer material is often used in dentistry for different types of implants and attachments. Properties like biocompatibility, workability and low toxicity levels make PMMA ideal for such and many other applications in biomedicine like lenses, bone fixators, bone cement, bone and scull cavity fillers. One of the in vitro methods for testing such PMMA dental splints and tooth interaction is presented in this paper where Al_2O_3 ceramic is used as a substitute for tooth material according to the related standard. The second member of this tribo-couple, the PMMA sample, is varied based on its polymerization mechanisms while artificial saliva of different pH values was used as medium in this tribosystem. Testing was conducted on apparatus specially designed to simulate wear during linear movement.

Key words: *wear, PMMA, Al_2O_3*

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DINAMIČKI RASPON FOTOGRAFIJA REALIZIRANIH DOMINANTNIM TEHNIKAMA ISPISA NA SJAJNIM PODLOGAMA ZA ISPIS

DYNAMIC RANGE OF PHOTOGRAPHS REALIZED WITH DOMINANT PRINTING TECHNIQUES ON GLOSSY PRINTING SUBSTRATES

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Izvorni znanstveni rad/Original scientific paper

Sažetak: U radu se analizira mogućnost praćenja reprodukcije tonova i boja u digitalnom fotografskom sustavu kroz sve faze, od snimane scene do realizacije, kroz dinamički raspon. Kao glavni ograničavajući faktor proširenja dinamičkog raspona cijelog sustava se ističe realizacija fotografije ispisom. U eksperimentalnom se dijelu rada, kroz maksimalne gustoće obojenja i prenosne krivulje, komparativno analiziraju realno postignuti dinamički rasponi ispisom na sjajnim podlogama za ispis dominantnim tehnikama ispisa digitalnog zapisa fotografije.

Ključne riječi: *dinamički raspon, HDR fotografija, ispis fotografije, podloga za ispis*

Abstract: This paper analyzes the possibility of monitoring the tone and color reproduction in digital photography system through all stages, from shooting scenes to realization, through a dynamic range. As the main limiting factor of the dynamic range expansion of the system the realization of photographs by printing is emphasized. In the experimental part of the paper, throught the maximum color density and transfer curves, the real dynamic range achieved by dominant printing techniques for digital photographs on glossy substrates, is comparatively analyzed**.**

Keywords: *dynamic range, HDR photography, photography printing, printing substrates*

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MIKROSTRUKTURNE PROMJENE ALUMINIZIRANOG AUSTENITNOG NEHRĐAJUĆEG ČELIKA

MICROSTRUCTURAL CHANGES OF ALUMINIZED AUSTENITIC STAINLESS STEEL

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Izvorni znanstveni rad/Original scientific paper

Sažetak: U ovome radu provedena je modifikacija površine austenitnog nehrđajućeg čelika X2CrNi19-11 visokotemperaturnim aluminiziranjem u smjesi prahova, u cilindričnoj retorti, u atmosferi inertnog plina argona pri temperaturi od 1000 °C tijekom 4 sata. Aluminizacija je provedena u smjesi prahova koja se sastoji se od tri komponente: aluminij u obliku finog praha koji se nanosi na površinu supstrata, $AlCl_3$ kao aktivator i korund (α–Al_2O_3) kao inertno punilo u obliku praha za sprečavanje sinteriranja smjese praha pri visokim temperaturama. Nakon aluminiziranja uzorak je podvrgnut žarenju u dva ciklusa po 60 min pri 700 °C u oksidirajućoj atmosferi. Svim uzorcima je izmjerena mikrotvrdoća HV0,025 (u osnovnom materijalu i u formiranom sloju) nakon aluminiziranja i oksidacije. Analiza mikrostrukture provedena je optičkom mikroskopijom.

Ključne riječi: *austenitni nehrđajući čelik, visokotemperaturno aluminiziranje, oksidacija*

Abstract: In this paper, surface modification of austenitic stainless steel X2CrNi19-11 was performed by high temperature aluminizing process in a mixture of powders in the cylindrical retort, in an atmosphere of inert argon gas at a temperature of 1000°C for 4 hours. For the aluminizing process the following mixture of powders was used: aluminum in the form of fine powder applied to the substrate surface, $AlCl_3$ as an activator and corund (α–Al_2O_3) as an inert filler in powder form to prevent sintering of powder mixtures at high temperatures. Aluminized sample was annealed in two cycles of 60 min at 700°C in oxidizing atmosphere. Microhardness HV 0.025 of bulk material and the aluminized coating was measured after aluminization and oxidation. Analysis of the microstructure was carried out by optical microscopy.

Keywords: *austenitic stainless steel, high temperature aluminizing, oxidation*

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PRIMJENA STATIČKE EKSTRAKCIJSKE METODE U METALURGIJI

USE OF STATIC EXTRACTION METHOD IN METALURGY

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Stručni rad/Professional paper

Sažetak: U ovom radu određivana je čistoća površine metalnih i keramičkih uzoraka. Uzorci su pripremljeni odmašćivanjem, brušenjem (mehaničko čišćenje) i uranjanjem u HCl, HNO_3 i H_2SO_4 u različitom vremenskom intervalu (kemijsko čišćenje). Čistoća površine praćena je automatskim mjerenjem otpora otopine.
Dobiveni rezultati ukazuju na to da čistoća uzoraka ovisi o načinu pripreme. Vidljivo je da je i mehanički i kemijski način čišćenja uzorka zadovoljavajući. Međutim, bolji rezultati dobiveni su prilikom čišćenja uzoraka uz upotrebu kiselina (kemijsko čišćenje). Statička ekstrakcijska metoda pokazala se kao izuzetno dobra metoda za mjerenje čistoće površine.

Ključne riječi: *statička ekstrakcijska metoda, čistoća uzoraka, mehaničko čišćenje, kemijsko čišćenje*

Abstract: In this paper, the surface cleanliness of metal and ceramic samples was determined.
Samples were prepared by degreasing, grinding (mechanical cleaning) and dipping in HCl, HNO_3 and H_2SO_4 (chemical cleaning) in different time intervals. Surface cleanliness was monitored by automatic measurement of resistance of the solution.
The obtained results indicate that the purity of the samples depends on the method of preparation. It is obvious that the mechanical and chemical cleaning provides satisfactory results. However, better results are obtained when the cleaning of samples was performed using acid (chemical cleaning). The static extraction method proved to be very good for the determination of surface cleanliness.

Keywords*: static extraction method, cleanliness of samples, mechanical cleaning, chemical cleaning*

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IMAGE ANALYSIS OF OLD GLAGOLITIC BOOKS BASED ON PHOTOGRAPHIC DIGITIZATION

SLIKOVNA ANALIZA STARIH GLAGOLJSKIH KNJIGA BAZIRANA NA FOTOGRAFSKOJ DIGITALIZACIJI

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Izvorni znanstveni rad/Original scientific paper

Sažetak: Područje glagoljičkog pisma i prvih knjiga tiskanih glagoljicom je tehnički i tehnološki slabo istraženo. Ovaj rad ispituje mogućnost tehničke podrške (ili eventualnu negaciju), povijesnog znanja i pretpostavki o počecima tiskarstva u Hrvatskoj pomoću fotografske digitalizacije i analize digitalnih zapisa programima „Maglica“ i ImageJ. Program "Maglica" izrađen je za potrebe ovog istraživanja i služi za statističku obradu dobivenih slika fotografskom digitalizacijom. Digitalni zapisi pojedinih stranica knjiga i njihovih pseudo3D prikazi ukazuju na to da se prikazanom metodom može odrediti karakteristični otisak - "fingerprint" tiskarske preše te da se na temelju ove metode određena knjiga može „pridružiti“ određenoj tiskarskoj preši ili tiskari.

Ključne riječi: *fotografska digitalizacija, pseudo3D, glagoljičke knjige, tiskarska preša*

Abstact: The area of Glagolitic script and the first printed books in Glagolitic has been technically and technologically poorly explored. The possibility of technical support (or possibly a denial), by photographic digitization and analysis of the digital records with so called “Vapour” and ImageJ program, of historical knowledge and assumptions about the origins of the printing in Croatia is presented in the paper. A computer program "Vapour" has been developed for the purposes of this study and used for statistical processing of digital records. Digital records of individual pages of the books and their pseudo-3D outlook indicate that the presented method can identify the typical impression – ‘fingerprint’ of the printing presses and, based on this method, a particular book can be “assigned” to a particular printing press or printing house.

Key words: *photographic digitization, pseudo3D, glagolitic books, printing press*

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RAZLIKA IZMEĐU SPOSOBNOSTI PROCESA U DUGOM I KRATKOM VREMENSKOM RAZDOBLJU

DIFFERENCE BETWEEN LONG-TERM AND SHORT-TERM PROCESS CAPABILITY

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Izvorni znanstveni rad/Original scientific paper

Sažetak: U literaturi se mogu naći različita tumačenja tzv. indeksa sposobnosti procesa. Ta su tumačenja često kontradiktorna i mogu unijeti zbrku u primjeni. Zbrka je uglavnom povezana s načinom procjenjivanja raspona procesa (standardnog odstupanja) i s tim u svezi primijenjene terminologije. Najveća zbrka se pojavljuje pri računanju i interpretaciji indeksa P_p, P_{pL}, P_{pU}, P_{pk}. Da li slovo "P" označava preliminarnu procjenu sposobnosti procesa ili značajku procesa? Ako se slovo "P" odnosi na preliminarnu procjenu tada nalazi punu i jasnu praktičnu primjenu. Razmotrimo određivanje razine kvalitete procesa i značenje indeksa sposobnosti procesa na stvarnom primjeru.

***Ključne riječi**: sposobnost procesa, kontrolne karte*

Abstract: In literature different interpretations of the so-called process capability index can be found. These interpretations are often contradictory and can cause confusion in usage. The confusion is mainly connected with the method of estimating the process range (standard deviations) and the respective applied terminology. The biggest confusion in calculation and interpretation of the capability index is introduced precisely by the indices P_p, P_{pL}, P_{pU}, P_{pk}. Does the letter "*P*" mean "*Preliminary*" or "*Performance*"? If "*P*" means "*Preliminary*" then it finds also its full and clear practical implementation. Let us consider the determination of the process quality level and the meaning of the process capability index using an actual example.

***Keywords**: process capability, control charts*

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KARAKTERIZACIJA KOROZIONIH PRODUKATA CIJEVOVODA

CHARACTERIZATION OF PIPELINE CORROSION PRODUCTS

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Pregledni rad/Subject review

Sažetak: Tijekom vremena zabilježena je učestala pojava korozionih produkata u fazi eksploatacije cjevovoda (koksare, termoelektrane, toplane i rashladnog sistema kontinuiranog lijevanja čelika). Za iznalaženje uzroka najčešće se primjenjuju metode metalografske i kemijske analize. No, dobiveni rezultati nisu uvijek bili zadovoljavajući. Zbog toga, metode su dopunjene metodama rentgenske difrakcije i elektronske mikroanalize, Za istraživanje uporabljeni su separirani uzorci. Uzeti uzorci su usitnjeni i homogenizirani u mlinu za usitnjavanje i homogenizaciju, tipa Spex. Pripremljeni uzorci istraženi su tehnikom filma (Dabye Scherr kamera) na uređaju za difraktometriju, tipa Philips uz uporabu $CoK_{\square}$ zračenja i pretražnom elektronskom mikroskopu, tipa Joel. Rezultati istraživanja obrađeni su matematički. Oni ukazuju na nehomogenu raspodjelu sumpora i/ ili njegovih identificiranih faza unutar istraživanih uzoraka kao i uzrok njihove pojave.

Ključne riječi: *karakterizacija, produkt korozije, rentgenska difrakcija, elektronska analiza*

Abstract: Over time frequent occurrence of corrosion products in the exploitation phase of pipelines (coking plant, power plant, heating system and cooling system of continuous casting steel) was observed. To find the causes the methods of metallographic and chemical analysis were most often used. However, the obtained results were not always satisfactory. Because of that the methods of X - ray diffraction and scanning electron microscopy were used. For the analyses the samples were separated. The taken samples were ground and homogenized in mixer mill, type Spex. The prepared samples were measured with film technique (Debye Scherr camera) on Philips diffractometer with the use of CoK_{α} radiation and scanning electron microscope, Joel type. The results of investigation were analyzed mathematically. The obtained results showed a non-homogenic distribution of phases and difference in phase composition of investigated samples. The non-homegenic distribution is caused by the origin of samples.

Keywords: *characterization, corrosion product,X–ray diffraction, electron probe analysis*

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TOPLOTNI EFEKAT U PROCESIMA DUBOKOG IZVLAČENJA SA VELIKIM BRZINAMA

HEAT EFFECT DURING THE PROCESS OF DEEP DRAWING WITH HIGH SPEEDS

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Izlaganje sa znanstvenog skupa/Conference presentation

Sažetak: Pri izvlačenju sa velikim brzinama u hladnom stanju dolazi do rasta temperature radnog predmeta zbog pretvaranja mehaničke energije u toplotnu.
U radu su dati izrazi za izračunavanje rasta temperature pod uvjetom adijabatskog procesa.
Rezultati dobiveni ovim proračunom dobro aproksimiraju rezultate dobivene eksperimentalnim mjerenjem.

Ključne riječi: *toplota, mehanička energija*

Abstract: The temperature of the workpiece rises during the drawing with great speed in the cold condition due to convertion of mechanical energy into heat.
This paper presents the equations for calculation of temperature rise, provided the adiabatic process.
The results obtained in this calculation well approximate the results obtained by experimental measurement.

Keywords: *heat, mechanical energy*

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INNOVATIONS OF INDUSTRIAL PRODUCTS BY KNOWLEDGE TRANSFER IN THE FIELD OF ALUMINIUM FOAM

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Pregledni rad/Subject review

Abstract: The aluminium foam is a very promising material for light and stiff structures, crash absorbing elements and further applications especially in the field of lightweight industrial design. The novel technology for production of reinforced aluminium foam developed recently possesses enormous future potential for applications where lightweight combined with high stiffness and acceptable manufacturing costs are of prime interest. The significant features ensured from the improvement of the aluminium foam properties are highlighted and the most promising industrial applications are suggested in this contribution.

The applying of aluminium foam is not an optimal technical solution at all events. Nevertheless, its utilization is indeed most competitive, particularly if two or more advantages are used at once. Typical example of its multifunctional usage is its application within car crash zones, where not only its high stiffness and lightweight design, but also the ability to absorb large amount of crash energy and high efficiency to damp down unfavorable vibrations thus reducing overall noise within the vehicle are utilized simultaneously. Reinforced aluminium foams can be successfully used in lightweight constructions, crash energy absorbers, machine parts with request to enhanced vibration damping and sound absorption as well as panels created thermal barriers and noise attenuators. They are very attractive for transport industry, especially for lightweight stiff body structures of cars, busses, trains, ships, airplanes, cableways, etc. They can be even successfully used for future novel 3D-shaped frameless shell structures of cars, where excellent performance (stiffness, strength and passive safety) is expected at minimum weight. Because of their excellent corrosion resistance, non-inflammability and the fact that they do not evolve toxic fumes in fire, they can be utilized also as decorative material for design applications, e.g. for passenger cabins in ships, dividing walls in airplanes, trains, cinemas, theatres, etc.

In order to use aluminium foam correctly it is important to understand the main structural principles for achievement of the required combination of component properties. The examples of proper design of aluminium foam components for various industrial applications has been outlined in this contribution in order to draw attention to incorrect use of this advanced engineering material and thus to prevent disproportionate growth of production costs.

Keywords: *aluminium foam, advanced engineering materials, knowledge transfer*

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DOD INK JET ISPIS KROMATSKIM BOJAMA CRNO-BIJELIH FOTOGRAFIJA NA RAZLIČITO DORAĐENIM PODLOGAMA ZA ISPIS

DOD INKJET PRINTING OF BLACK AND WHITE PHOTOGRAPHS WITH CHROMATIC COLORS ON SUBSTRATES WITH DIFFERENT FINISHING

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Prethodno priopćenje/Preliminary note

Sažetak: U radu se opisuje i analizira DOD ink jet ispis kao jedna od dominantnih tehnika ispisa digitalnih zapisa fotografija. Ispituju se utjecaj dorade podloge za ispis na karakteristike ispisa crno-bijelih fotografija koje se, uz ispis crnom, ispisuju i akromatskim bojama. Rezultati ukazuju na razlike u ispisu na ispitivanim podlogama te, općenito, odstupanja od neutralne, akromatske, boje pogotovo u područjima srednjih i tamnih tonskih vrijednosti, tj. optičkih pokrivenosti površina.

Ključne riječi: *DOD ink jet, crno-bijela fotografija, podloga za ispis, optička pokrivenost, dinamički raspon*

Abstract: This paper describes and analyzes the DOD ink jet printing as one of the dominant techniques for digital photography printing. The effect of substrate finishing on characteristics of black and white photographs printing, which are printed not only with black, but also with achromatic colors is analyzed. The results indicate differences in the printing of the tested substrates and, in general deviations from neutral, achromatic color, particularly in areas of medium and dark tonal values, i.e., optical coverage area.

Keywords: *DOD ink jet, black and white photography, print media, optical coverage, dynamic range*

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UTJECAJ HRAPAVOSTI POVRŠINE NA DEBLJINU SLOJA PREMAZA

INFLUENCE OF SURFACE ROUGHNESS ON THE COATING THICKNESS

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Izvorni znanstveni rad/Original scientific paper

Sažetak: U radu je, teorijski i eksperimentalno, istražen utjecaj mikrogeometrijskog stanja površine na debljinu sloja premaza. U teorijskom dijelu rada analizirani su parametri hrapavosti površine te su definirani osnovni pojmovi i opći zahtjevi koji se postavljaju na kvalitetu premaza. U eksperimentalnom dijelu rada dan je proračun potrebne količine premaza u ovisnosti o stanju hrapavosti površine. Također je procijenjena kvaliteta mjernog sustava kod primijene magnetske metode mjerenja debljine premaza.

Ključne riječi: *hrapavost površine, debljina sloja premaza*

Abstract: In this paper, the influence of surfacesmicrogeometry on coating thicknesses is researched theoretically and experimentally. In the theoretical part the surface roughness parameters are analyzed and the basic concepts and general requirements that are placed on the coating quality are defined. The calculation of the coating quantity in dependence on the state of surface roughness is presented in the experimental part of the work. In this work the quality of the measurement system of the magnetic method for coating thickness measurements is also estimated.

Keywords: *surface roughness, coating thicknesses*

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POBOLJŠANJE KOROZIJSKE POSTOJANOSTI NEHRĐAJUĆEG ČELIKA NANOSTRUKTURIRANIM SOL-GEL TiO_2 FILMOVIMA

IMPROVEMENT IN CORROSION RESISTANCE OF STAINLESS STEEL BY MEANS OF NANOSTRUCTURED SOL-GEL TiO_2 FILMS

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Prethodno priopćenje/Preliminary note

Sažetak: U ovom su radu na podloge od nehrđajućeg čelika X5 CrNi 1810 (AISI 304) naneseni keramički nanostrukturirani TiO_2 tanki filmovi sol-gel postupkom tehnikom uranjanja. Za pripravu dva sola (sol 1 i sol 2) korišten je titanov izopropoksid kao prekursor, propanol kao otapalo, uz dodatak nitratne kiseline kao katalizatora te acetilacetona za peptizaciju. Oba pripravljena sola sadrže istu količinu navedenih komponenti, razlika je samo u dodatku polietilenglikola (PEG) u sol 2. Nakon priprave solova provedeno je nanošenje prevlaka postupkom uranjanja u sol, sušenje te kalciniranje na temperaturi od 550 °C. Ispitan je i utjecaj broja slojeva te parametara hrapavosti na korozijsku postojanost navedenih filmova na nehrđajućem čeliku. Parametri hrapavosti sol-gel filmova analizirani su mikroskopijom atomskih sila (AFM). Korozijska postojanost nehrđajućeg čelika s i bez filmova ispitana je u simuliranom morskom okolišu u 3 %-tnoj vodenoj otopini NaCl. Mjerenja su provedena elektrokemijskom impedancijskom spektroskopijom (EIS). Rezultati su pokazali da otpornost korozije filmova ovisi o vrijednostima parametara hrapavosti i broju slojeva.

Ključne riječi: *sol-gel, TiO_2 filmovi, nehrđajući čelik, korozija, EIS*

Abstract: In this paper, ceramic nanostructured TiO_2 thin films on X5 CrNi 1810 (AISI 304) stainless steel were deposited by sol-gel process and dip-coating technique. For the preparation of two solutions (sol 1 and sol 2) titanium isopropoxide was used as a precursor, propanol as a solvent, with addition of nitric acid as a catalyst and acetylacetone for peptization. Both of the prepared sols contained the same amount of mentioned components, the only difference was in the addition of polyethylene glycol (PEG) to sol 2. After preparation of solutions, deposition of coatings by dip-coating technique was made, followed by drying and calcining at the temperature of 550°C. Influences of the number of layers and the roughness parameters on corrosion resistance of both films on stainless steel were examined. Roughness parameters of sol-gel films were analyzed by atomic force microscopy (AFM). The corrosion behaviour of the coated stainless steel substrate was evaluated by electrochemical impedance spectroscopy (EIS) in a 3 wt. % aqueous NaCl solution. The obtained results showed that the corrosion resistance of films depends on the values of roughness parameters and the number of layers.

Keywords: *sol-gel, TiO_2 film, stainless steel, corrosion, EIS*

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MICROSTRUCTURAL CHARACTERIZATION OF Ti-BASED ALLOYS

MIKROSTRUKTURNA KARAKTERIZACIJA LEGURA NA BAZI TITANA

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Izvorni znanstveni rad/Original scientific paper

Sažetak: U zadnje vrijeme sve se više razvijaju legure titana za biomedicinsku primjenu koje ne sadrže nepoželjne elemente, aluminij i vanadij. Ovaj rad prikazuje mikrostrukturnu karakterizaciju dvije skupine legura na bazi titana. U prvoj je titan legiran s kromom i molibdenom, a u drugoj su titanu dodani niobij i cirkonij. Svrha ovog rada je ispitati mikrostrukturu i tvrdoću Ti-Cr-Mo i Ti-Nb-Zr legura za potencijalnu primjenu u biomedicini. Kemijski sastavi istraživanih legura odabrani su iz istog dijela ternarnog faznog dijagrama bogatog titanom, te prema sličnim biomedicinskim legurama na bazi titana. Po tri uzorka različitog sastava od svake skupine legura laboratorijski su pripremljeni u lučnoj peći. Njihova mikrostruktura je ispitana scanning elektronskim mikroskopom s energijsko-disperzivnim spektrometrom. Analiza sastava provedena je analizom u točki i linijskom analizom. Tvrdoća je određena Vickersovom metodom. Rezultati pokazuju da su Ti-Cr-Mo legure dvofazne, odnosno da sadrže β i α ili α“ fazu, dok su Ti-Nb-Zr legure uglavnom β-jednofazne s ω-fazom u tragovima. EDS analiza je pokazala da α (α“) i β faze imaju vrlo sličan kemijski sastav, koji odgovara sastavu legure. Tvrdoća prema Vickersu Ti-Cr-Mo legura povećava se s udjelom molibdena u leguri, dok se ona za Ti-Nb-Zr legure povećava s udjelom niobija. Zbog skoro β-jednofazne mikrostrukture i niže tvrdoće u odnosu na Ti-Cr-Mo legure, Ti-Nb-Zr legure imaju veći potencijal za primjenu kao biomedicinski materijali.

Ključne riječi: *legure na bazi titana, biomedicinski materijali, mikrostruktura, tvrdoća prema Vickersu*

Abstract: In a few last decades the development of biomedical titanium alloys without undesirable elements, aluminium and vanadium, has continued to increase. This paper shows microstructural characterization of two groups of titanium-based alloys. First, titanium was alloyed with chromium and molybdenum. In the second type, niobium and zirconium were added to titanium. Purpose of this investigation was to examine the microstructure and hardness of Ti-Cr-Mo and Ti-Nb-Zr alloys with potential for biomedical use. The chemical compositions of investigated alloys were selected from the same corner of ternary titanium rich diagram and according to the similar biomedical Ti-based alloys. Three samples with different composition of each alloy type were laboratory prepared by an arc melting method. Their microstructure was examined by scanning electron microscope with energy-dispersive spectrometer (EDS) by point and line analysis. Hardness was determined by Vickers method. The results show that Ti-Cr-Mo alloys have two-phases microstructure containing β and α or α” phase, while Ti-Nb-Zr alloys were nearly β single-phase with traces of ω-phase. EDS analysis indicates that α and β have similar chemical composition which is in a good agreement to alloy composition. Vickers hardness of Ti-Cr-Mo alloys increases with molybdenum content, while those for Ti-Nb-Zr alloys increase with niobium content. According to the closely single-phase microstructure and lower hardness, Ti-Nb-Zr alloys have advantage as potential biomedical materials.

Keywords: *Ti-based alloys, biomedical material, microstructure, Vickers hardness*

ADSORPTION ISOTHERMS OF COBALT IONS REMOVAL USING ZEOLITE 13X

MODELI IZOTERMI ZA UKLANJANJE KOBALTA ZEOLITOM 13X

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Izvorni znanstveni rad/Original scientific paper

Sažetak: U ovom radu je ispitano uklanjanje iona kobalta iz vodene otopine korištenjem zeolita 13X u šaržnom reaktoru. Ispitan je utjecaj početne koncentracije kobalta, pri konstantnoj temperaturi, na proces sorpcije. Dobiveni eksperimentalni podaci testirani su korištenjem Langmuirove, Freundlichove, Sipsove, Tothove i Redlich-Petersonove izoterme pri čemu su bolje slaganje s eksperimentalnim podacima pokazale troparametarske izoterme.

Ključne riječi: *kobalt, zeolit 13X, izoterme*

Abstract: The sorptive removal of cobalt ions from aqueous solutions using zeolite 13X has been studied by a batch technique. The impact of solute concentration at constant temperature on the process of sorption was examined. Langmuir, Freundlich, Sips, Redlich - Peterson and Toth isotherms were fitted to experimental data and their goodness-of-fit were calculated. Three parameter isotherms were found to give a better fit to experimental data than Langmuir and Freundlich.

Keywords: *cobalt, zeolite 13X, isotherms*

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UNAPREĐENJE POSLOVA PODMAZIVANJA U ŠEĆERANI PRIMJENOM INFORMACIJSKOG SUSTAVA ODRŽAVANJA

IMPROVEMENT OF LUBRICATION IN SUGAR COMPANY THROUGH THE APPLICATION OF MAINTENANCE INFORMATION SYSTEM

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Izlaganje sa znanstvenog skupa/Conference presentation

Sažetak: U radu se daje analiza procesa i organizacijske strukture službe strojarskog održavanja u šećerani „Sladorana“ d.d. Županja. Budući se u planu održavanja, između ostalih, naglašava strategija preventivnog održavanja, ona je posebno opisana. Posebno je analiziran proces preventivnog održavanja na primjeru podmazivanja. Na osnovi analize aktivnosti i potrebnih resursa, izrađen je plan podmazivanja odabrane opreme, te je pokazano praćenje podmazivanja, odnosno aktivnosti preventivnog održavanja u informacijskom sustavu održavanja.

***Ključne riječi**: podmazivanje, preventivno održavanje, informacijski sustav održavanja*

Abstract: The paper shows the analysis and process of maintenance in ”Sladorana” d.d. Županja sugar company. The maintenance plan specially emphasizes the strategy of preventive maintenance, so it has been described in particular. Special attention was given to the preventive maintenance process in the case of lubrication. Based on activity analysis and needed resources, the lubrication plan of selected equipment was made. Lubrication activities monitoring based on the created plan and preventive maintenance activities in a maintenance information system has been shown.

***Keywords:** lubrication, preventive maintenance, maintenance information system*

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UTJECAJ TOPLINSKE OBRADE NA MEHANIČKA SVOJSTVA VISOKO ČVRSTOG ČELIKA ZA OPRUGE 51CrV4

INFLUENCE OF HEAT TREATMENT ON MECHANICAL PROPERTIES OF 51CrV4 HIGH STRENGTH SPRING STEEL

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Izvorni znanstveni rad/Original scientific paper

Sažetak: Trajnost opruga ograničena je plastičnom deformacijom, otpornosti na umor i krhkosti materijala. Iz tog aspekta preporučena svojstva materijala za izradu opruga su: visoka duktilnost i žilavost pri radnoj temperature od -40°C do + 50°C te dobra prokaljivost koja osigurava zahtijevana mehanička svojstva i pri maksimalnim dimenzijama. Stoga je za proizvođače opruga vrlo bitna informacija o mogućim toplinskim obradama te svojstvima koja se mogu njima postići. U ovom radu opisan je utjecaj parametara toplinske obrade na vlačnu čvrstoću, konvencionalnu granicu razvlačenja, lomnu i udarnu žilavost kao funkciju temperature popuštanja u rasponu od 350 °C do 700 °C za određenu temperaturu austenitizacije. Također prikazana je razlika između svojstava dobivenih modeliranjem toplinske obrade u računalnom programskom paketu Hardenability i ispitanih na ispitnim uzorcima obrađenim prema modeliranim parametrima.

Ključne riječi: *čelici za opruge, toplinska obrada, lomna žilavost, udarna žilavost, vlačna čvrstoća*

Abstract: The durability of the springs is limited by plastic deformation, fatigue and fracturing. From this point of view, the use of spring steel with following properties is recommended: high ductility and toughness at operation temperature from -40°C to + 50°C, good hardenability that provides required mechanical properties, even at maximum dimensions. For the manufacturers of springs, the information relating to the heat treatment of specific spring steel is important. This paper describes the influence of heat treatment parameters on tensile strength R_m, proof strength $R_{p0.2}$, fracture toughness K_{Ic}, impact toughness Charpy-V as a function of tempering temperature in the range from 350°C to 700°C for a specific austenitizing temperature. Also, the difference between the properties given by the mathematical modelling of heat treatment in Hardenability and the properties obtained by testing the heat treated samples will be presented.

Key words: *spring steels, heat treatment, fracture toughness, impact toughness, tensile strength*

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INFLUENCES OF INHOMOGENEITY OF THICKNESS OF THIN FILMS CREATED BY DIFFERENT DEPOSITION PROCESSES ON MECHANICAL PROPERTIES

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Prethodno priopćenje/Preliminary note

Abstract: The paper deals with the evaluation of inhomogeneity of thickness of thin films, which was created by different deposition processes. Inhomogeneity of thickness can influence the properties and the behaviour of systems thin film – substrate. The inhomogeneity of thickness was evaluated, namely, by X-ray fluorescent method. The thin films created by PVD, CVD and PA CVD deposition process are evaluated. The mechanical properties and the behaviour are evaluated, namely, by indentation methods scratch indentation and static indentation with different value of normal force, different modes of measurement and by using different kinds of indenters.

Keywords**:** *thin films, inhomogeneity of thickness, x-ray fluorescence, static indentation, scratch indentation, mechanical properties*

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EVALUATION OF METHODS FOR ANALYSIS OFSURFACE LAYERS ANALYSIS OF POLYMER MATERIALS AFTER TEMPERATURE DEGRADATION BY NANOINDENTATION

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Izlaganje sa znanstvenog skupa/Conference presentation

Abstract: The paper deals with the evaluation of methods for the analysis of surface layers of polymer materials after temperature stress by nanoindentation analytic method. The degradation process influences surface properties of materials and material systems and creates surface layers on these materials or changes properties and behaviour to the depth under surface of material systems. The degradation process by temperature has influence on some kind of polymer materials and influence properties and behaviour to the depth of these materials from surface. Nanoindentation measurement by different measured modes and different value of load are used for the evaluation of changing of properties and behaviour of polymer materials. The changing of chemical composition is evaluated by X-ray fluorescent method.

Keywords: *surface layers, mechanical properties, nanoindentation, x-ray fluorescence, ageing of polymers*

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PRILAGODBA TISKOVNE FORME ZA FLEKSOTISAK KVALITATIVNIM ZAHTJEVIMA

ADJUSTMENT OF FLEXOGRAPHIC PRINTING PLATE TO MEET QUALITATIVE REQUIREMENTS

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Stručni rad/Professional paper

Sažetak: Fleksotisak je tehnika tiska koja je danas široko primijenjena u tisku ambalaže, a karakterizirana je elastičnom tiskovnom formom u kombinaciji s upotrebom bojila niske viskozosti što omogućava tisak na široki spektar tiskovnih podloga. Prilagodba tiskovne forme za fleksotisak zahtjevima kvalitete uključuje razmatranje osnovnih parametara u postupku izrade tiskovne forme digitalnim putem, direktno iz računala (CtP). Poznato je da su elastičnost tiskovne forme i deformacije koje se javljaju tijekom procesa otiskivanja tehnološki nedostatak ovog tipa tiskovnih formi. Cilj ovog rada bio je definirati i prezentirati model prilagodbe postupka izrade tiskovne forme za fleksotisak kako bi se postigli optimalni rezultati u tisku. Rezultati ispitivanja su ukazali na nužnost definiranja zatvorenog sustava reprodukcije koji uključuje i povezuje tri segmenta: postupak izrade tiskovne forme, tiskarski sustav i tiskovnu podlogu.

Ključne riječi: *fotopolimer, digitalna izrada tiskovne forme (CtP), krivulja prilagodbe tonskih vrijednosti*

Abstract: Flexography is nowadays widely used in the packaging production. It is characterized by flexible printing plates and low viscosity printing ink which enables printing on a wide range of printing substrates. Adjustment of the flexographic printing plate to match qualitative requirements includes consideration of the basic parameters in the digital printing plate making processes (Computer to Plate). It is known that the flexibility of the printing plate and deformations that occur during the reproduction process are considered to be the technological limitations of this technique. Therefore, the aim of this paper was to define and present a model for the adjustment of the procedures included in flexographic printing plate making in order to achieve optimal reproduction results. Results of the investigation have shown the necessity of defining a closed reproduction system which includes and combines three segments: printing plate, printing system and the printing substrate.

Keywords: *photopolymer, Computer to Plate (CtP), compensation curve*

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PRINCIPI UŠTEDE U SUSTAVU NOVINSKOG OFFSET TISKA

SAVING PRINCIPLES IN NEWSPAPER OFFSET PRINTING

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Izvorni znanstveni rad/Original scientific paper

Sažetak: Nagli razvoj tehnike u sve jačoj mjeri zahvaća i grafičku struku što u procesu proizvodnje novina postavlja i dodatne zahtijeve na svojstva tiskovnih papira, tiskarskog bojila i ostalih parametara za novinske rotacije. Konfiguracije novinskih ofset rotacija, nisu prilagođene održavanju stabilnosti kvalitete tiska što kod tiska novina u koloru inducira poteškoće. Sve navedeno novinsku ofset proizvodnju čini izuzetno složenom, s obzirom da na istu utječe niz parametara koji su povezani s tiskarskim strojem, vodenom otopinom i tiskovnom formom, pri izuzetno visokim brzinama za tisak. Stoga, uslijed utjecaja tako velikog broja različitih parametara, na konačnu kvalitetu novine, te velikog broja mogućih načina na koje je moguće implementirati parametre u konačni oblik, odnosno novinu, u realnoj novinskoj proizvodnji, ne postiže se uvijek zadovoljavajuća kvaliteta.

Ključne riječi: *novinska ofset rotacija, novina, roto papir, tiskarska bojila, vodena otopina*

Abstract: The sudden and fast development of technology penetrates graphic design and technologies more and more, thus setting additional requirements that must be met in production, with regard to the print paper quality, printing ink and other parameters for rotary newspaper printing presses. The configurations of rotary newspaper offset printing presses are not adapted to maintenance of the stability of the print quality, therefore inducing problems when printing newspapers in color. All the above makes the offset newspaper production extremely complex, particularly because this process is subject to a series of parameters relating to the press, water solution and printing technique, all this at extremely high printing speeds. Accordingly, and because of the impact by so many different parameters, the final quality of the printed newspaper and the large number of possible implementation methods of these parameters in the final product, i.e. the newspaper, it is not always possible to accomplish a satisfactory quality of the newspaper in real production.

Key words: *newspaper offset rotary press, newspaper, rotary press paper, ink, water solution*

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UPORABNA TRAJNOST FUNKCIONALNO TISKANIH TEKSTILNIH MATERIJALA

USAGE DURABILITY OF FUNCTIONALLY PRINTED TEXTILE MATERIALS

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Stručni rad/Professional paper

Sažetak: Sa svrhom vrednovanja uporabne trajnosti tekstilnih materijala u uvjetima primjene, u radu su ispitivanja provedena na tri bijela pletiva, različitog prepleta i sirovinskog sastava, namijenjena izradi majica. U cilju prijenosa čitljivih informacija, tehnikom sitotiska i transfer tiska su na svakom od pletiva u crnoj boji otisnuta dva QR koda s različitom količinom informacija u dvije veličine. Na početnim i funkcionalno otisnutim uzorcima pletiva, a u svrhu praćenja utjecaja simulirane njege i nošenja, utvrđene su dimenzijske promjene nakon višestrukih ciklusa pranja i sušenja te otpornost na habanje i sklonost stvaranju površinskog pilinga pomoću habalice po Martindaleu. Definirana je uporabna kvaliteta pletiva, utvrđen utjecaj simulirane primjene na estetska svojstva gotovog proizvoda te utjecaj trošenja na gubitak mase materijala, postojanost obojenja otiska i čitljivost otisnutih informacija na nosivom mediju. Utvrđeno je da strukturne karakteristike pletiva, njihova dimenzijska stabilnost, broj provedenih ciklusa pranja i sušenja, broj provedenih habajućih ciklusa, način tiska te veličina površine otisnutih polja u QR kodu imaju utjecaj na dobivene rezultate.

***Ključne riječi**: tekstilni materijali, pletiva, tisak, simulacija primjene i njege, trošenje*

Abstract: With the purpose of durability evaluation of the textile materials in conditions of use, the paper investigates the quality of three white knitted fabrics, of different structural and construction characteristics, intended for T-shirts. In order to transfer readable information, on each of the fabrics two QR codes with different amounts of information in two sizes were printed using screen-printing and transfer printing techniques. On non-printed and functionally printed fabrics, with the purpose of monitoring the influence of simulated wear and care, dimensional changes after multiple cycles of washing and drying were determined, as well as the abrasion resistance and the tendency to surface peeling using Martindale abrader. The usage quality of fabrics was defined, and the effect of simulated application on aesthetic properties of the finished product, the impact of wearing on materials mass loss, print color fastness and readability of printed information on the carrier medium were determined. It was found that structural characteristics of knitted fabrics, their dimensional stability, the number of washing and drying cycles, and the number of wear cycles performed, the printing technique and size of black modules in QR code as well have influence on the results obtained.

***Key words**: textile materials, knitted fabrics, printing, usage and care simulation, wear*

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KEMIJSKA I MORFOLOŠKA ANALIZA PEPELA RAZLIČITIH VRSTA KRUTOG GORIVA

MORPHOLOGY AND COMPOSITION OF ASH OF VARIOUS SOLID FUELS

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Stručni rad/Professional paper

Sažetak: U radu je provedena karakterizacija pepela nakon izgaranja kamenog ugljena i smjesa kamenog ugljena s patentnim gorivom u dva različita omjera (0,54 kg ugljena + 10 ampula patentnog goriva i 0,44 kg ugljena + 8 ampula patentnog goriva). Patentno gorivo je po svom kemijskom sastavu smjesa aluminijevih i kalcijevih soli, pakirano u polipropilenske ampule s visokom ogrjevnom vrijednosti koja iznosi čak 95,69 MJ/kg. Za potrebe izgaranja goriva korišten je standardni toplovodni kotao na kruto gorivo snage 70 kW. Nakon izgaranja, pepeo je uzorkovan s dna ložišta.
Uzorcima pepela nakon određivanja ogrjevne vrijednosti, određen je i elementarni sastav CHNS analizom. Kemijski sastav glavnih i sporednih elemenata određen je energijskim disperzivnim spektrometrom (EDXRF). Morfološke karakteristike uzoraka pepela određene su pretražnom elektronskom mikroskopijom (SEM) u kombinaciji s energetsko disperzivnom analizom X-zrakama (EDX).

Ključne riječi: *pepeo, karakterizacija, EDXRF, SEM-EDX*

Abstract:
In this paper the characterization of ashes obtained during combustion of pure coal and mixtures with different ratios of coal and patent fuel (0.54kg of coal + 10 ampoules with patent fuel, 0.44kg of coal + 8 ampoules with patent fuel) was performed. According to its chemical composition, the patent fuel is a mixture of aluminium and calcium salts, packed in polypropylene ampoules. It has got high calorific value which is 95.69MJ/kg. The standard boiler for solid fuels, with power of 70kW has been used for the purposes of combustion of these fuels. After combustion, ash has been sampled from the bottom of furnace and from flue gases on the quartz filters.
The calorific value of ash samples was determined. Elementary composition was determined by means of CHNS analysis. The amount of the main and minor elements in investigated ash samples was determined by means of energy dispersive X-ray fluorescence (EDXRF), while morphology was analysed by scanning electron microscopy (SEM-EDS).

Keywords: *bottom ash, characterization, EDXRF, SEM-EDX*

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PRIPRAVA I KARAKTERIZACIJA SLOJEVITOG DVOSTRUKOG HIDROKSIDA

PREPARATION AND CHARACTERIZATION OF ACETATE LAYERED DOUBLE HYDROXIDE

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Izlaganje sa znanstvenog skupa/Conference presentation

Sažetak: Pripravljena je mineralna faza koja strukturno pripada grupi slojevitih dvostrukih hidroksida. Osnovni sloj strukture je pozitivno nabijen i čine ga kalcij i aluminij, $[Ca_2Al(OH)_6]^+$, a između slojeva se nalaze molekule vode i negativno nabijeni acetat ioni koji kompenziraju naboj. Pripravljeni spoj pripada klasi slojevitih dvostrukih hidroksida, tzv. anionskih glina, te je od interesa u kemiji cementa jer se javlja kao produkt degradacije betona pod djelovanjem kalcijeva acetata (sredstvo protiv smrzavanja prometnica) ili nastaje u cementnim materijalima kada se kalcijev acetat rabi kao ubrzivač vezanja. Pripravljeni je spoj karakteriziran metodama infracrvene spektrometrije (FTIR), simultane razlikovne pretražne kalorimetrije i termogravimetrijske analize (DSC/TGA) i rendgenske difrakcijske analize praha (XRD).

Ključne riječi: slojeviti dvostruki hidroksidi, AFm faze, kalcij-acetat

Abstract: Chemical reaction between $Ca_3Al_2O_6$ and $Ca(CH_3COO)_2$ at 25°C in water yielded predominately $Ca_3Al_2O_6{\cdot}Ca(CH_3COO)_2{\cdot}xH_2O$, a compound that belongs to the class of layered double hydroxides (LDH). LDH compounds have layered structures, in this case consisting of positively charged $[Ca_2Al(OH)_6]^+$ units, having water molecules and acetate anions between layers, the latter compensating the electric charge. The product prepared is of considerable interest in cement chemistry because it can be found as corrosion product of deicing salt calcium acetate, $Ca(CH_3COO)_2$, reaction with concrete, and as a possible product of Portland cement hydration under the influence of calcium acetate used as a setting accelerator. The compound prepared had been analyzed by X-ray powder diffraction, infrared spectroscopy (FTIR) and simultaneous differential scanning calorimetry and thermo-gravimetry (DSC/TGA).

Keywords: layered double hydroxide LDH, AFm phase, calcium-acetate

ISPITIVANJE UBRZIVAČA VEZANJA PORTLAND CEMENTA

INVESTIGATION OF PORTLAND CEMENT SETTING ACCELERATOR

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Stručni rad/Professional paper

Sažetak: Hidratacija portland cementa (PC) nastupa odmah po dodatku cementa u vodu. Tijekom hidratacije dolazi do istodobnog otapanja pojedinih minerala PC klinkera i taloženja novih hidratnih spojeva, pri čemu se neprekidno mijenja kemijski sastav iona otopljenih u vodi kao posljedica interakcije niza fizikalno-kemijskih procesa. Na reakciju hidratacije PC u praksi namjerno se utječe uporabom tvari koje nazivamo dodatcima za beton. Uporaba aditiva izaziva znatne učinke tijekom vezanja svježeg cementnog kompozita, zatim modificira njegova reološka svojstva, a utječe i na konačna svojstva očvrslog materijala. U ovom radu, predmet znanstvenog interesa je utjecaj kalcijevog klorida kao ubrzivača vezanja na hidrataciju portland cementa. Za sve dokazane učinke (ubrzanje vezanja, povišenje ranih tlačnih čvrstoća) određena je optimalna količina dodatka kalcijevog klorida. Istražena je priroda produkata hidratacije portland cementa uz dodatak kalcijevog klorida kao ubrzivača vezanja metodama rendgenske difrakcijske analize (XRD) i infracrvene spektroskopije (FTIR).

***Ključne riječi**: portland cement, ubrzivači vezanja, hidratacija, vrijeme vezanja, čvrstoća*

Abstract: Portland cement (PC) hydration consists of numerous individual physicochemical processes in complex interaction, e.g. processes of individual PC clinker minerals dissolution and precipitation of diverse hydration products. Hydration reaction is affected by substances dubbed concrete additives. These substances cause notable effects during the hydration reaction of fresh cement composite and modify its rheological properties, as well as those of hardened material. The scientific focus of this paper is the effect of calcium chloride, $CaCl_2$, as setting accelerator on Portland cement hydration. In order to draw conclusions, it was necessary to determine optimal quantities of added $CaCl_2$ for all effects tested (setting acceleration, increase in early compressive strengths etc.) The nature of the products of Portland cement hydration with $CaCl_2$ addition was tested with X-ray diffraction analysis (XRD) as well as infrared spectroscopy (FTIR) methods.

***Keywords**: Portland cement, setting accelerators, hydration, setting time, strength*

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ANALYSIS OF HEAT TREATMENT INFLUENCE ON THE HARDNESS OF STEEL EN 42CrMo4

ANALIZA UTJECAJA PARAMETARA TOPLINSKE OBRADE NA TVRDOĆU ČELIKA EN 42CRMO4

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Stručni članak/Professional paper

Sažetak: Hollomon i Jaffe su dali funkcionalnu ovisnost parametra popuštanja (temperature i trajanja) P=f(T, τ). Drugim riječima ako se koriste kombinacije temperature i trajanja popuštanja, koje rezultiraju jednakom vrijednošću parametra, tvrdoća će ostati nepromijenjena. Ova funkcija se odnosi samo na čelike. Za određivanje parametara popuštanja uz postizanje željene tvrdoće nakon obrade, potrebno je poznavati dijagram popuštanja promatranog čelika. U ovom radu je istražena mogućnost dobivanja izraza gdje je tvrdoća u funkciji temperature i vremena popuštanja (*H=f(T, τ)*). Plan pokusa i statistička analiza rezultata su obavljeni korištenjem programa „Design expert 6.0“. Izrađeni su cilindrični uzorci duljine 20 mm i promjera 15 mm.

Ključne riječi: *Toplinska obrada, parametri popuštanja, tvrdoća*

Abstract: Hollomon and Jaffe have given the functional dependence of the annealing parameters (temperature and time) P = f (T, τ). In other words, if using a combination of temperature and annealing time, resulting in equal parameters value, hardness will remain unchanged. This function refers only to steels. To determine the parameters of annealing for desired hardness after treatment, it is necessary to know the annealing diagram (*H=f(T)*) of the observed steel. This paper investigates the possibility of obtaining a mathematical model where the hardness is function of annealing temperature and time (*H=f(T, τ)*). Design of experiments and statistical analysis were performed using the program "Design Expert 6.0". The cylindrical specimens were 20 mm in length and 15 mm in diameter.

Keywords: *heat treatment, annealing parameters, hardness*