



Fakulteta za
industrijski inženiring
Faculty of Industrial Engineering

2ND International Scientific Conference on the Development of Industrial Engineering (MK RI²):

Smart Specialisations, Entrepreneurship,
Innovation, and Human Resources

**2. Mednarodna znanstvena konferenca
Razvoja industrijskega inženiringa (MK
RI²): Pametne specializacije,
podjetništvo, inovacije ter človeški viri**

Conference Proceedings Abstracts

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2. MEDNARODNE ZNANSTVENE KONFERENCE RAZVOJA INDUSTRIJSKEGA INŽENIRINGA (MK RI²): Pametne specializacije, podjetništvo, inovacije ter človeški viri, Pule, 19. april 2017

2nd INTERNATIONAL SCIENTIFIC CONFERENCE ON THE DEVELOPMENT OF INDUSTRIAL ENGINEERING (MK RI²): Smart Specialisations, Entrepreneurship, Innovation, and Human Resources, Pule, 19 April 2017

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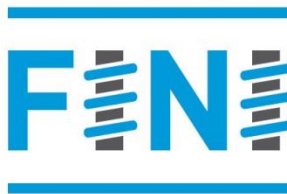
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Fakulteta za
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Foreword

The Faculty of industrial engineering Novo Mesto in cooperation with the Chamber of Commerce Dolenjska and Bela krajina organized on 19 April 2017 at Estate Pule its 2nd International Scientific Conference on the Development of Industrial engineering. The purpose of the conference was to open a dialogue between academia and entrepreneurs of the Dolenjska region and other parts of Slovenia. The content of the conference included an overview of the activities in the field of *Smart Specialization, Entrepreneurship, Innovation and Human Resources*. The conference invited nine plenary lectures. The academic sphere was represented with two lectures; three lectures were presented by colleagues from institutes, and four lectures by colleagues from industry. The themes of the plenary lectures touched on the substantive policy of the conference with a slight emphasis on innovation, Industry 4.0 and digitization in industries. After the plenary lectures, a round table was conducted on the topics presented with an emphasis on the problems encountered of daily work practice. The discussions were very lively and from the discussions the participants were given new insights and proposals for further work. After the break two additional sessions followed with a total of ten lectures. Both of the sections were marked by the open discussion on solving open problems of direct industrial practices and some impressions of how young researchers come to the research work at domestic and foreign universities. At the conference representatives of universities from England, Russia, and Hungary also participated. The conference ended in a relaxed conversation and participants were able to view the posters of students in the restaurant of Pule Estate.

Jože Vižintin

President of the Programming Committee

Predgovor

V organizaciji Fakultete za industrijski inženiring Novo Mesto in v sodelovanju z Gospodarsko zbornico Dolenske in Bele Krajine je bila 19. Aprila 2017 na posestvu Pule 2. mednarodna konferenca z naslovom Razvoj industrijskega inženiringa. Namen konference je bil odpreti sproščen dialog med akademsko sfero in podjetniki Dolenjske regije ter ostalih delov države Slovenije. Vsebina konference je obsegala pregled dejavnosti na področju *Pametne specializacije, podjetništva, inovacij ter človeških virov*. Na konferenci je bilo predstavljenih devet plenarnih predavanj. Akademsko sfero je predstavila dve predavanji, tri predavanja so prispevali predstavniki inštitutov, ostala štiri predavanja pa so predstavili kolegi iz industrije. Tematika plenarnih predavanj se je dotikala vsebinske usmeritve konference z mogoče rahlim poudarkom na inovacijah, industriji 4.0 in digitalizaciji v industriji. Po plenarnih predavanjih je sledila okrogla miza, na kateri so udeleženci v sproščenem pogovoru razpravljali o vsebinah predstavljenih plenarnih predavanj, s poudarkom na problemih s katerimi se srečujejo pri delu v vsakdanji praksi. Ob tem je treba poudariti, da je bila diskusija zelo živahna. Iz razprave so udeleženci lahko izluščili veliko novih spoznanj in predlogov za nadaljnje delo. Po odmoru sta sledili še dve sekciji s skupno desetimi predavanji. Obe sekciji je zaznamovala odprta diskusija o reševanju odprtih problemov iz neposredne industrijske prakse in nekaj prikazov, kako mladi raziskovalci pristopajo k raziskovalnemu delu na domačih in tujih univerzah. Na konferenci so sodelovali tudi predstavniki univerz iz Anglije, Rusije in Madžarska. Konferenca se je končala v sproščenem pogovoru in ogledu posterjev študentov v restavraciji posestva Pule.

Jože Vižintin

Predsednik programskega odbora

Plenarna predavanja

Plenary Lectures

Čas je za tehnološki in inovacijski preboj Slovenije, Slovenija z mednarodne perspektive

It is Time for a Technological and Innovative Breakthrough of Slovenia, Slovenia, with an International Perspective

Jože Vižintin*

Zaslužni profesor, Univerza v Ljubljani | Professor Emeritus, University of Ljubljana

*joze.vizintin@tint.fs.uni-lj.si

Povzetek

Slovenija nima nafte, plina in drugih strateških surovin. Ima pa izredno veliko kvalitetnega lesa (65 % je gozdne površine), kakovostno pitno vodo, ki postaja v svetu velik posel, lepo naravno okolje in veliko sposobnih, visoko izobraženih in inovativnih ljudi. Torej, če se Slovenija želi povzpeti na raven inovacijsko razvitih držav srednje evropske regije, mora izkoristiti vse dane prednosti in popraviti slabosti, ki jih ima.

Po osamosvojitvi smo razmišljali o Sloveniji kot deželi specialistov in izobilja. Žal analize kažejo, da so se vsi razvojni modeli dosedanjih strategij, ki so imeli namen Slovenijo popeljati v visoko razvito državo, pokazali za neučinkovite, ker nismo razvili novih tehnologij in proizvodov, katerih podlaga je novo znanje, rezultat pa proizvodnja z visoko dodano vrednostjo. Preveč poudarjeno pričakovanje o učinkih novega, je bil tudi eden od vzrokov za potop mnogih zrelih (tradicionalnih) tehnologij. Dosedanje strategije in zasnove za tehnološko razvojno politiko niso prinesle novih ukrepov, ki bi povzročili novo paradigmo tehnološkega razvoja, ampak so nadaljevale stare prakse.

Trenutno so slovenska podjetja podhranjena z razvojnimi kadri, v primerjavi z Avstrijo moramo število razvojnih inženirjev podvojiti, v primerjavi s Finsko pa potrojiti. To lahko dosežemo samo s spremembo zaposlovanja mladih strokovnjakov tako, da uvedemo, po vzoru nekaterih zahodnih držav tako imenovani Model kroženja strokovnjakov med industrijo in akademsko sfero. Namesto, da se zaposlujejo na univerzah in inštitutih, kjer imamo sedaj 78 odstotkov vseh raziskovalcev v vladnem raziskovalnem sektorju, je potrebno povečati zaposlovanje teh strokovnjakov v podjetjih, razvojnih centrih in tehnoloških parkih in s tem preprečiti ali vsaj omejiti njihov odhod v tujino.

Vzpostaviti je treba ponovno sinergijo in povezovanje z znanostjo! Znanstveniki ne bodo nikoli razvijali, raziskovalci in razvojni inženirji pač. To je specialno delo kombiniranja in selekcije, vpletanja kupca, konkurence, izogibanje sovražnih patentov. Zato ni potrebe, da silimo znanstvenike v to, jih je pa potrebno vpeti v voz razvoja za potrebe industrije. Sinergijo morajo iskati podjetja v medsebojnem sodelovanju, združevanju razvojnih moči, z delitvijo nalog in

področij na osnovi timskega dela. Ponovno bo potrebno spoznanje, da so ključni dejavnik za nov razvojno-inovacijski proces inženirji. Le tako si bo Slovenija zagotovila boljši in vplivnejši položaj v svetu.

Zaradi hitrih globalnih, socialnih, političnih, ekonomskih in tehnoloških sprememb, se čedalje bolj zaostrojuje pogoji za izvoz naših izdelkov in tehnologij v članice EU in v države izven EU. Zato bodo potrebne hitre spremembe v strategiji razvoja tradicionalne, izvozno usmerjene slovenske industrije, ki zaposluje veliko ljudi in omogoča investicije v nove produkte in tehnologije z visoko dodano vrednostjo.

Glede na rezultate analize uresničevanja dosedanje Raziskovalno-Inovacijsko strategije 2011-2020 bi bilo, potrebno ponovno preučiti vse slabosti in pripraviti novo Vizijo in Strategijo razvojno-inovacijskega sistema. Da bi lahko natančno opredelili vizijo in zagotovili doseganje zastavljenih ciljev nove raziskovalno-inovacijske strategije je potrebno v Pametni specializaciji opredeljena področja vgraditi v Inovacijski proces. Kot sledi iz utemeljitve Pametne specializacije ima Slovenija na sprejetih področjih možnosti za kontinuiran inovacijski razvoj in preboj na svetovne trge. Zato je potrebno sprejeti zavezujočo vizijo za razvoj Slovenije: Slovenija bo država, ki je znana po: inovativnih, izvozno usmerjenih, visoko tehnoloških podjetjih, ki bodo vodilna v izbranih nišah na globalnem trgu.

Iz vizije mora izhajati vodilna usmeritev Slovenije: cilj ukrepov in delovanja vseh mora biti uspešno gospodarstvo z visoko dodano vrednostjo. Povečevanje produktivnosti ni dovolj, potrebni so inovativni izdelki in storitve z višjo dodano vrednostjo.

Ključne besede: inovacije, razvoj, strategija, tehnologija, novi produkti

Abstract

Slovenia does not have oil, gas and other strategic raw materials. It has, however, extremely great high-quality wood (65 % of forest areas), quality of drinking water, which is becoming in the world a great deal, a beautiful natural environment and many capable, highly educated and innovative people. So, if Slovenia wants to elevate the level of innovation of the developed countries of central European region must use all the given advantages and correct the disadvantages that it has.

After independence, we think of Slovenia as a land of specialists and affluent. Unfortunately, the analyses show that all the development models of previous strategies, which had the purpose of Slovenia to lead in a highly developed country, showed to be ineffective, because we have not developed new technologies and products, which is based on the new knowledge, the result of production with high added value. Too many stressed the expectation about the effects of the new, was also one of the causes for the sinking of many mature (traditional) technologies. So far the strategy and design for technology policy are not brought home to the new measures, which would lead to a new paradigm of technological development, but continued the old practice.

At the moment Slovenian companies are undernourished with the development of human resources, in comparison with Austria we have a number of development engineers to double in comparison with Finland, however, attempt to triple its. This can be achieved only by a change of employment of young professionals so as to introduce, following the example of some western countries of the so-called Model of the circulation of experts between industry and academia. Instead, to employ the universities and institutes, where we now have 78 per cent of all researchers in the government research sector, it is necessary to increase the employment of these professionals in enterprises, development centers and technology parks and thus prevent or at least limit their departure abroad.

It is necessary to establish again the synergy and connectivity with science! Scientists will never be developed, researchers and development engineers. This is the special work of combining and selection, interlacing customer, competition, the avoidance of hostile patents. Therefore, there is no need to forcing scientists in this; they have mounted in the car development for the needs of the industry. Synergy must seek the company of mutual cooperation, combining the development power, with the division of tasks and areas on the basis of teamwork. Again it will require a realization that the key factor for the new development-the innovation process engineers. The only way you will Slovenia ensure a better and a stronger position in the world.

Due to rapid global, social, political, economic and technological change is increasingly exacerbating conditions for the export of our products and technologies in the EU member states and in countries outside the EU. Therefore, the need for rapid changes in the development strategy of traditional, export-oriented Slovenian industry, which employs many people and allows investment in new products and technologies with high added value.

Depending on the results of the analysis of the implementation of the current Research and Innovation strategy 2011-2020 would be necessary to re-examine all the weaknesses and prepare a new Vision and Strategy of the development of the innovation system. To be able to accurately define the vision and ensure the achievement of the objectives of the new research and innovation strategy is needed in the Smart specialisation defined areas fit into the Innovation process. As follows from the rationale of Smart specialisation has Slovenia in the adopted areas of opportunities for continuous innovation and development breakthrough on the world markets. Therefore it is necessary to make a binding vision for the development of Slovenia: Slovenia will be a country that is known for: innovative, export-oriented, high-tech companies, who will be the leader in selected niches of the global market. The vision must come the guiding policies of Slovenia: the objective of the measures and the performance of all must be a successful economy with high added value. Increasing productivity is not enough; it requires innovative products and services with higher added value.

Keywords: innovation, development, strategy, technology, new products

Article Classification: Professional Paper

Industry 4.0: Internet of Things and Cognitive Manufacturing

Dejan Podgoršek*

IBM Slovenija, d.o.o.

*dejan.podgorsek@si.ibm.com

Povzetek

Internet stvari nam danes omogoča, da dobivamo podatke o stanju v proizvodnji, (delovanju sistemov, izkoriščenju zmogljivosti, vibracijah strojev, temperaturi, vlagi, meritve merilnih inštrumentov,...) v realnem času. Zbrani podatki nam omogočajo izboljšanje kvalitete in funkcionalnosti izdelkov ter na drugi strani optimizacijo proizvodnih, nabavnih in prodajnih procesov ter s tem izboljšanje zadovoljstva kupcev in zmanjšanje stroškov. Kognitivni sistemi v proizvodnji nam omogočajo razumevanje podatkov v realnem času in priporočila za izboljšave. Pri tem pa moramo biti izredno previdni pri integraciji OT in IT sistemov, predvsem zaradi varnosti.

Abstract

As more factories and equipment are instrumented with IoT, data volume will only grow larger. Conventional computing will struggle to scale with the large influx of data and the complexity of the analytics. Computing must become cognitive to process, analyse, and optimise the information. To truly pave the way forward to Industry 4.0 and beyond, manufacturing has to evolve into cognitive manufacturing.

Cognitive manufacturing fully utilises the data across systems, equipment and processes to derive actionable insight across the entire value chain from design through manufacture to support. Built on the foundations of IoT and employing analytics combined with cognitive technology, cognitive manufacturing drives at key productivity improvements in quality, efficiency, and reliability of the manufacturing environment.

Cognitive manufacturing transforms manufacturing in three focused ways:

- Intelligent assets and equipment: utilising connected sensors, analytics, and cognitive capabilities to sense, communicate and self-diagnose issues in order to optimise performance and reduce unnecessary downtime
- Cognitive processes and operations: analysing a variety of information from workflows, context, process, and environment to drive quality, enhance operations and decision-making
- Smarter resources and optimisation: combining various forms of data from individuals, location, usage, and expertise with cognitive insight to optimise and enhance resources such as labour, workforce, and energy.

Article Classification: Professional Paper

Senzorske tehnologije za zaznavanje prisotnosti vozil

Sensor Technologies for Vehicle Presence Detection

Jerneja Žganec Gros* & Mario Žganec

Alpineon, d.o.o.

*jerneja@alpineon.si

mario.zganec@alpineon.si

Povzetek

Zanesljivo zaznavanje prisotnosti vozil je ključnega pomena pri računalniškem vodenju in optimizaciji prometa v mestih. Lahko pričakujemo, da bo v prihodnosti vsako vozilo samodejno sporočalo svojo pozicijo mestnemu sistemu za vodenje prometa, vendar do trenutka, ko bo takšna funkcionalnost delovala zanesljivo in bo obvezno vgrajena v vsakem vozilu, lahko poteče vsaj še desetletje, ali dva. Do tedaj bodo sistemi za vodenje prometa potrebovali senzorje, ki v realnem času zagotavljajo informacije o stanju na prometnih in parkirnih površinah.

Trenutno je v uporabi nekaj različnih metod zaznavanja prisotnosti vozil: aktivni in pasivni senzorji, vgrajeni v vozišče, ki zaznavajo prisotnost feromagnetnega materiala v bližini sensorja; kamere, ki s pomočjo postopkov analize slike ugotavljajo prisotnost vozil na sliki; mikrovalovni, laserski in ultrazvočni aktivni senzorji, ki zaznavajo odboj oddane energije od površin vozila; sistemi, ki temeljijo na zaznavanju radijskih oddajnikov (Bluetooth, WiFi) v mobilnih napravah, ki so prisotne v vozilih. Naštete metode se razlikujejo po zanesljivosti, robustnosti, obsegu informacij, ki jih zaznajo (pozicija, hitrost, vrsta vozila), načinu vgradnje in ceni.

V predavanju bodo predstavljene prednosti in slabosti teh metod ter opisani novejši dosežki na področju zaznavanja prisotnosti vozil. Pokazano bo tudi, kako se obravnavana tematika umešča v tematsko področje Pametnih mest in skupnosti v okviru Pametne specializacije S4, in to na primerih SRIP Pametna mesta in skupnosti ter programa EkoSMART, v okviru katerega se razvija ekosistem pametnega mesta kot povezan sistem vrednostnih verig.

Ključne besede: senzorske tehnologije, pametna mesta, zaznavanje vozil

Abstract

Reliable vehicle identification technologies are of essential importance for traffic management and optimization in smart cities. In the future, every vehicle will be expected to transmit its position to the local traffic management system. This transmission is expected to be reliable

and mandatory for all vehicles within a decade or two. Until then traffic management systems will need to rely on data from sensor networks that provide real-time occupancy data for traffic surfaces and parking spaces.

Currently several methods for automatic vehicle detection are in use: active and passive sensors embedded into the road surface that sense the presence of a ferromagnetic material in the vicinity; cameras capable of detecting vehicles based on image processing of the captured scene; microwave, laser and ultrasound active sensors sensing the reflectance of the emitted energy from the vehicle surface; and systems that are sensing radio transmitters (Bluetooth, WiFi) of mobile devices present in the vehicles. All these methods differ in terms of reliability, robustness, diversity of detected data (position, velocity, and vehicle type), installation and price.

We will highlight the advantages and disadvantages of these methods and present the newest achievements in the field. We will show this topic is embedded into the priority pillar Smart cities and communities under the umbrella of the Smart Specialization Strategy based on two examples: the national Strategic and Innovation Partnership SRIP PMiS and the programme EcoSmart that aims at building an ecosystem of a smart city as a unified system of connected value chains.

Keywords: sensor technologies, smart cities, vehicle detection

Article Classification: Scientific Research Paper

Student interaction with the Local Business Community

Graham Rogerson* & Colin Rigby

Keele University, Great Britain (Velika Britanija)

*g.a.rogerson@keele.ac.uk

c.a.rigby@keele.ac.uk

Abstract

The last few years has seen increasing interaction of Universities with the local business community. This is largely motivated by the desire to provide more authenticity into the curriculum and thereby augment skills naturally acquired by more traditional modules and more traditional curriculum delivery. This presentation will outline some curriculum changes and mechanisms whereby more authenticity is provided. Additionally, some case studies will also be presented, both illustrating and elucidating how interaction with the local community is not just beneficial to the student, but also to the company. A range of company types, from large and well-known companies, such as JCB and the local premier league football club Stoke City, to small start-up companies and charities, will be used as illustrative examples.

Keywords: student interaction, local business community, authenticity, case studies

Article Classification: Professional Paper

Escalation Practices in Automotive Development

Tomaž Jurejevčič*

Hella Saturnus Slovenija d.o.o. Ljubljana
Fakulteta za industrijski inženiring Novo mesto | Faculty of Industrial Engineering Novo mesto
*jurejevcic.tomaz@gmail.com

Jernej Slanovec

Hella Saturnus Slovenija d.o.o. Ljubljana
jernej.slanovec@hella.com

Abstract

In automotive business many risk-involved situations occur and when detected, an escalation process takes place. Although defined and controlled by process guidelines and being supported by experts, escalation brings increased emotional pressure and stress for parties involved. The purpose of the article is to present current status and analysis of escalation processes and gaps between theory and practice cases. Methods of analyses involve practical cases from automotive development process, lessons learned, anonymous survey of automotive engineers and classification of experiences. Results of the survey show that the controlled escalation process for know-how related escalations is needed in order to establish the environment where the team is able to provide new, sometimes unconventional ideas for the problem to be solved. Recommendations of good engineering practices and measures are derived that enable organization and managers to put the expertise and experiences of employees into action for problem solving during escalation.

Keywords: escalation process, stress, lessons learned, supplier chain, automotive development

Article Classification: Scientific Research Paper

Razvoj avtomatizirane vožnje

Automated Driving Development

Tomaž Savšek*

TPV d.o.o., Novo mesto

*t.savsek@tpv.si

Povzetek

V članku bomo osvetlili začetke avtomatizirane vožnje ter evropsko pobudo za razvoj inteligentnega vozila. Predstavili bomo avtomatizirano vožnjo kot eno od ključnih področij razvoja cestne mobilnosti. Osvetlili bomo družbene izzive, pregledali glavne dejavnike in cilje razvoja ter poti uvajanja avtomatizirane vožnje. Posebej bomo predstavili pot razvoja avtomatiziranih osebnih vozil in pot razvoja avtomatiziranih gospodarskih vozil. Poti razvoja osebnih vozil in gospodarskih vozil bodo zaokrožili sistemi v urbanem okolju, ki bodo v bodočnosti omogočali avtomatizirano vožnjo. Že danes so v vozilih vgrajeni sistemi, ki presegajo in dopolnjujejo človekove sposobnosti. Od tu bomo skozi članek gradili razvojno pot vse do leta 2030, ko se predvidevajo aplikacije že povsem avtonomnih vozil v cestnem prometu. Zaključili bomo s skupno vizijo in predstavili različne vidike uvajanja tovrstnih sistemov v cestno mobilnost.

Ključne besede: avtomatizirana vožnja, cestna mobilnost, urbano okolje, razvojna pot

Abstract

The article will highlight the beginnings of automated driving and a European initiative for the development of intelligent vehicles. We will introduce automated driving as one of the key areas for the development of road mobility. We will discuss societal challenges; review the main factors and goals of the development and introduction of automated driving roadmaps. We will present the development of automated passenger cars and the way of the development of automated commercial vehicles. Paths of the development of passenger cars and commercial vehicles will complement the systems in an urban environment, which will in future enable automated driving. We will finished with a shared vision on automated driving inroad mobility until 2030.

Key words: automated driving, road mobility, urban, development roadmap

Article Classification: Scientific Research Paper

Industrija 4.0 v okviru krožne (trajnostne) proizvodnje in sonaravnega razvoja, Gonilna sila za inovativne izdelke, procese in sisteme za novo generacijo proizvodnje

Industry 4.0 within Sustainable Manufacturing and Sustainable Development, the Driving Force for Innovative Products, Processes and Systems for the Production of a New Generation

Vojteh Leskovšek*

član IAS

*vojteh.leskovsek@imt.si

Povzetek

Slovenija ne more biti le stroškovno konkurenčna, temveč mora biti predvsem inovacijsko konkurenčna, zato je uveljavitev inženirstva, eden od pogojev, da bomo lahko s sodelovanjem med akademsko sfero in industrijo dosegli višjo stopnjo tehnologije tudi v t. i. zrelih proizvodnjah, da bodo lahko ponovno primerljive z najbolj razvitimi državami EU. Z novimi tehnološko zahtevnimi programi in boljšim znanjem pa omogočili postopen prehod v sonarvni (trajnostni) razvoj. Celotna raziskovalna sfera, vključno z raziskovalci in razvojniki iz gospodarstva mora biti vključena v trikotnik znanja (univerze-JRO-raziskovalci v gospodarstvu) in vključena v celoten inovacijski proces. Te inovacijske mreže morajo krepiti sodelovanje v verigah vrednosti. Prav tako je potrebno zagotavljati neprekinjen proces usposabljanja poklicnega, tehniškega in inženirskega kadra. Poklicne šole, visoke šole, univerze in inštituti so v dobrem položaju, da zagotovijo programe izobraževanja in usposabljanja.

Kreiranje proizvodnje izdelkov, ki uporabljajo in zagotavljajo postopke z minimalnimi vplivi na okolje, varčujejo z energijo, so varni za zaposlene in so ekonomsko smiselni ter uporabljeni materiali in izdelki sposobni ponovne uporabe, so načela krožne (trajnostne) proizvodnje (*sustainable manufacturing*), ki je eden od osnovnih elementov sonaravnega (trajnostnega razvoja) in povsod po svetu dosega vse večjo veljavo in podporo ter omogoča prehod iz linearne v eksponencialno gospodarsko rast. Ob gospodarskih družbah, ki zagotavljajo recikliranje so možne različne oblike krožnih (trajnostnih) procesov. Slovenska avtomobilska industrija mora ob sodelovanju s kovinsko industrijo, strojogradnjo in energetiko zagotavljati tako imenovana 3R - 6R načela krožne (trajnostne) proizvodnje: **Recover**, **Recycle**, **Redesign**, **Reduce**, **Remanufacture**, **Reuse**. Na ta način bomo prešli iz pretežno tradicionalne v zeleno oziroma krožno (trajnostno) proizvodnjo z večjo dodano vrednostjo in manjšim vplivom na okolje.

Za vzpostavitev vrednostnih verig med podjetji kovinske industrije, avtomobilske in ostalih vej na osnovi krožne (trajnostne) proizvodnje, obstajajo v Sloveniji vsi pogoji. Tradicija industrijske proizvodnje, kakovosten proces izobraževanja na vseh stopnjah, raziskovalni potenciali na univerzah in inštitutih, izkušnje pri prenosu znanja, majhne razdalje med industrijskimi obrati so lahko velike prednosti slovenske industrije. Ob kakovostnem visokošolskem izobraževanju, povezavi s tujimi univerzami, povezavi raziskovalnih inštitutov in univerz lahko v Sloveniji zagotovimo specifično zasnovano t. i. Industrijo 4.0, ki bo sposobna na določenih nišnih segmentih tekmovati na globalnem trgu.

Ključne besede: Industrija 4.0, krožna proizvodnja, sonaravni razvoj, 3R - 6R načela krožne proizvodnje, izobraževanje

Abstract

Slovenia can not only be cost-competitive, but must above all be innovative-competitive, therefore the implementation of engineering, is one of the conditions that we can through collaboration between academic sphere and industry achieve a higher level of technology in the so-called "traditional production" which could once again be comparable with the manufactures in most developed EU countries. With the new high-tech programs and better knowledge we could make it possible for a gradual transition to sustainable development. Therefore, the entire research community, including researchers and developers from the industry must be incorporated in the knowledge triangle (university – PRO - researchers in the economy) and included in the entire innovation process. These innovation networks should strengthen cooperation in the value chain. It is also necessary to ensure a continuous process of training of professional, technical and engineering personnel. Vocational education, high schools, universities and institutes are in a good position to provide education and training programs.

Creating manufacturing of products which using and providing processes with minimal impact on the environment and save energy, are safe for employees and economically significant, using materials and products which are able to be re-use are the principle of sustainable manufacturing, which is one of the basic element of sustainable development and all over the world achieves increasing effect and support which enables transition from linear to exponential growth. With commercial companies that provide recycling are possible different forms of sustainable processes. Slovenian automotive industry should, in cooperation with the metal working industry and energy sector ensured so-called 3R - 6R principles of sustainable manufacturing: Recover, Recycle, Redesign, Reduce, Remanufacture, Reuse. In this way, Slovenia will progressed from a largely traditional production in the green or sustainable manufacturing with higher added value and lower environmental impact.

To establish a value chains among enterprises of metal industry, automotive and other branches on the basis of a sustainable manufacturing in Slovenia exist all conditions. The tradition of industrial production, process quality education at all levels, research potentials at the universities and institutes, experience in knowledge transfer, as well as small distances between industrial plants can be significant advantages of Slovenian industry. On the basis of

high-quality of higher education at Slovenian universities, in conjunction with the foreign universities and related research institutes, Slovenia can provide specifically designed the so-called Industry 4.0 approach, which will be capable in certain niche segments to compete in the global market.

Keywords: Industry 4.0, sustainable manufacturing, sustainable development, 3R - 6R principles of sustainable manufacturing, izobraževanje, **Recover**, **Recycle**, **Redesign**, **Reduce**, **Remanufacture**, **Reuse**

Article Classification: Professional Paper

Analiza površin v znanosti o materialih - AES in XPS v metalurgiji

Surface Analysis in Material Science - AES and XPS in Metallurgy

Monika Jenko*

Inštitut za kovinske materiale in tehnologije

*monika.jenko@imt.si

Povzetek

Delovanje površin materialov je odločilnega pomena v našem življenju. Večina fizikalno kemijskih procesov se začne na površinah, kot npr. oksidacija, rekristalizacija, korozija, nitriranje, naogljčenje, spajkanje, metalurgija prahov, obraba, enofazni in multifazni kompozitni materiali, nanostrukturirani materiali itd. Zato je pomembno dobro razumevanje fizikalno kemijskih procesov na površini uporabljenih materialov.

Za popolno razumevanje lastnosti in reaktivnosti površin so pomembne informacije: fizikalna topografija, kemijska sestava, kemijska struktura, atomska struktura, elektronsko stanje in podrobni opis vezave molekul na površini. Žal ne obstaja nobena analitska tehnika, ki bi zagotovila vse te informacije. Podrobna raziskava površinskih pojavov vedno pogojuje uporabo več različnih analitskih tehnik.

Pomemben prispevek k razvoju na vseh področjih znanosti o materialih in metalurgiji je bil v zadnjih desetletjih dosežen s pomočjo analize površin, predvsem z uporabo Spektroskopije Augerjevih elektronov (AES) in rentgenske fotoelektronske spektroskopije (XPS).

AES je najbolj pomembna in razširjena metoda za kemijsko analizo površin prevodnih vzorcev. V metalurgiji je karakterizacija materialov na nano skali pogosto najbolj pomembna za razumevanje obnašanja materialov. To je posebno pomembno v primerih kjer vključki, precipitati, meje zrn in druge nehomogenosti odločilno vplivajo na lastnosti preiskovanih materialov.

Visoka površinska občutljivost AES metode nam omogoča vpogled v lastnosti osnovnega materiala kovinskega vzorca. S prelomom vzorca v ultravisokem vakuumu(UHV) lahko analiziramo sveže transkristalne in interkristalne ploskve, meje zrn in faz. V takem primeru lahko študiramo osnovni material (angleško: bulk) kot tudi pojave na mejah zrn in faz in tako lahko ustvarimo oziroma razvijemo nove sodobne materiale.

Predstavljeno bo več primerov uporabe AES in XPS metod v laboratoriju za karakterizacijo površin na IMT za raziskave problemov v metalurgiji.

Ključne besede: materiali, metalurgija, površine, meje zrn, meje faz, AES, XPS

Abstract

The surface behaviour of materials is very important in our lives. The properties, in terms of oxidation, corrosion resistance, carburizing, nitriding, soldering, powder metallurgy, machining, wear resistance, lubrication and a wide range of general interfacial fracture problems in single-phase, multi-phase and composite materials as well as nanostructured materials and weight reduction for a given application have all improved steadily over the years in response to a growing competition in the market place. It is therefore significant that the surface properties and behaviour of the materials used are fully understood.

To understand the properties and reactivity of a surface, the following information is required: the physical topography, the chemical composition, the chemical structure, the atomic structure, the electronic state and a detailed description of the bonding of molecules at the surface. There is no technique that can provide all these different pieces of information. A full investigation of a surface phenomenon will always require several techniques. To solve particular problems it is seldom necessary to have all these different aspects covered; however, it is almost always true that understanding is greatly advanced by applying more than one technique to a surface study.

A considerable contribution to the advancements on all the frontiers of metallurgy in previous decades has been made by surface analysis, in particular by using Auger Electron Spectroscopy (AES) and X-ray Photoelectron Spectroscopy (XPS).

AES is today the most important chemical surface-analysis tool for conducting samples.

In metallurgy, material characterization on the nanoscale is often an essential part for understanding material behaviour. It is very much so in situations where inclusions, precipitates, grain boundaries, and other forms of inhomogeneity essentially influence the properties of the substance under study. The high surface sensitivity of AES may enable us to get an insight into the bulk properties of a metallic sample. By fracturing the sample in a UHV environment, fresh trans-crystal and inter-crystal facets, grain boundaries and phases are exposed to examination. In such a way, truly bulk material as well as phenomena on grain boundaries and phases can be studied.

Several typical examples where AES and XPS are used in laboratory for surface characterization at IMT to resolve problems related to metallurgy will be presented.

Key words: materials, metallurgy, surfaces, grain boundaries, phases, AES, XPS

Article Classification: Scientific Research Paper

Trajnostne tehnologije

Sustainable Technologies

Processing of Synthetic Fuels by Nanoalloy Catalysts

Imre Kovács*

University of Dunaújváros, Hungary

*kovacsimre@uniduna.hu

Abstract

The increasing demand of fuel and the shortage of crude oil sources of the world makes the research on renewable and alternative energy sources relevant both from theoretical and industrial point of view. Some of these promising candidates – such as hydrogen, biogas – are still not involved in our everyday live. There is a technology, Fischer-Tropsch synthesis, which offers a solution. With the help of nanoalloys of cobalt (or iron) and some noble metals, synthetic fuel can be manufactured. Some results on the formation, characterization of these alloys will be presented in this study. Based on X-ray absorption methods, EXAFS and NEXAFS, we could give an overview and interpretation on this technology.

Keywords: nanoparticles, cobalt alloys, fuel

Article Classification: Scientific Research Paper

Določitev optimalnega dolivnega sistema v orodju za brizganje polimerov

Determining Optimum Feeding System in Tools for Splashing Polymers

Marko Gazvoda¹ & Marica Prijanovič Tonkovič*²

¹ Tomplast d.o.o.

² Fakulteta za industrijski inženiring Novo mesto | Faculty of Industrial Engineering Novo mesto

gazvodamarko@gmail.com

*marica.prijanovic-tonkovic@guest.arnes.si

Povzetek

Pri izdelavi izdelkov iz elastomera je pomemben dolivni sistem, po katerem teče talina elastomera, da na koncu dobimo ustrezen izdelek. V prispevku je predstavljena optimizacija dolivnega sistema pri orodju za brizganje elastomera.

Pri izdelavi optimizacije dolivnega sistema je bila uporabljena računalniška simulacija brizganja, ki je bila narejena s programsko opremo Cadmould. Na orodju s kombinacijo toplokanalnega in hladnokanalnega dolivnega sistema je bil optimiran hladnokanalni dolivni sistem. Za preiskavo smo uporabili elastomer vrste TPE TC8COZ trdote 80 Shore A. Preiskovali smo dva načina dovoda taline v kalupno votlino in sicer dovod polimera skozi osem in šestnajst dolivnih ustij. Na osnovi analiz je bil izdelan dolivni sistem, kjer se je zapolnjevala kalupna votlina skozi šestnajst dolivnih ustij. Tako je bila omogočena boljša nastavitvev brizgalnih parametrov in posledično boljše dovajanje elastomerne taline v kalupno votlino brez pregrevanja in deformacij, ki degradirajo elastomerno talino.

Ključne besede: analiza, brizganje, elastomer, kalupna votlina, optimiranje, parametri

Abstract

In making products from elastomers, injection system through which the melt of elastomer flows, is very important in order to achieve the adequate product. This article presents the optimization of the injection system in the elastomer injection tool.

In optimization process of the injection system a computerized simulation of injection was used and it was made with Cadmould software. On the tool with a combination of hot runner and cold runner injection system, the latter was optimized. For this research we used elastomer

of type TPE TC8COZ of hardness 80 Shore A. We researched two ways of feeding the melt into the mould cavity i.e. the feeding of polymers through eight and sixteen injection gates. Based on analysis we made a injection system where the mould cavity was filled through sixteen injection gates. This ensured better settings of injection parameters and consequently better feeding of elastomer melt into the mould cavity without overheating and deformations which impair elastomer melt.

Keywords: analysis, injection, elastomer, mould cavity, optimization, parameters

Article Classification: Scientific Research Paper

Inovativna tehnologija izboljšave kakovosti debeline mokre plasti tesnilnega materiala

Innovative Technology for Improving the Quality of Wet Layer Thickness of a Sealing Material

Erik Hartman³, Luka Ilič², Teodor Ivanuša², Alen Pavlič², Simon Razpet¹, Jure Svetelj³, Blaž Žnidaršič¹, Anatolij Nikonov*¹, Annmarie Gorenc Zoran¹, Igor Plazl³ & Ksaver Meško⁴

¹ Fakulteta za industrijski inženiring Novo mesto | Faculty of Industrial Engineering Novo mesto

² Univerza v Ljubljani | University of Ljubljana
Fakulteta za strojništvo | Faculty of Mechanical Engineering

³ Univerza v Ljubljani | University of Ljubljana
Faculty of Chemistry and Chemical Technology | Fakulteta za kemijo in kemijsko tehnologijo

⁴ Donit Tesnit d.o.o.

*anatolij.nikonov@fini-unm.si

Povzetek

V okviru »Javnega razpisa projektno delo z gospodarstvom in negospodarstvom v lokalnem in regionalnem okolju - Po kreativni poti do znanja 2016/17« izvajamo projekt, katerega namen je spodbujanje krepitve sodelovanja in povezovanja visokošolskega sistema z industrijo. Projekt izvaja Fakulteta za industrijski inženiring Novo mesto v sodelovanju s podjetjem DONIT TESNIT d.o.o., ki je eden izmed vodilnih proizvajalcev tesnilnih plošč.

Vsebina predlaganega projekta obravnava razvoj tehnologije izdelave mehkega tesnilnega materiala po mokrem postopku. Akademski partner bo v sodelovanju s podjetjem preko vključevanja študentov prispeval k reševanju problema kontrole kakovosti tesnil.

Mehki tesnilni materiali so ploskovne tvorbe iz katerih se konficionirajo tesnila. Tesnila preprečujejo uhajanje tekočega ali plinastega medija iz zaprtega sistema ter hkrati varujejo medij pred zunanjim onesnaženjem. Mehka tesnila se uporabljajo na spojnih mestih cevovodov za transport tekočin, in sicer v prirobničnih sistemih, ventilih, črpalkah, kompresorjih, motorjih z notranjim izgorevanjem, toplotnih prenosnikih, sistemih ogrevanja itd.

Pri proizvodnji tesnilnega materiala se na formirnem stroju pojavlja razlika v debelini mokre plasti, ki posledično vodi do tehnoloških izgub. Nadzor (kontrola) debeline se vrši ročno na določeno časovno frekvenco. Avtomatizacija procesa kontrole debeline tesnilnega materiala bo prispevala k izboljšanju konkurenčnosti podjetja. Nenazadnje lahko rezultati projekta močno

prispevajo k reševanju ekoloških problemov oz. problemov onesnaževanja okolja, ker bo optimizacija proizvodnega procesa, omogočila manjše količine izpustov kemikalij v ozračje.

Projekt finančno podpirajo Ministrstvo za izobraževanje, znanost in šport Republike Slovenije, Evropska unija iz Evropskega socialnega sklada in Javni študentski, razvojni, invalidski in preživitveni sklad Republike Slovenije v okviru Operativnega programa za izvajanje evropske kohezijske politike v obdobju 2014-2020.

Ključne besede: tesnilni materiali, tanka plast, kontrola kakovosti, avtomatizacija, proizvodni procesi

Abstract

The project is running within the public tender for creative approaches on intense collaboration and networking of higher education partners with (non-)economy sector in local and regional surrounding («Javni razpis projektno delo z gospodarstvom in negospodarstvom v lokalnem in regionalnem okolju - Po kreativni poti do znanja 2016/17»). The purpose of the project is to promote the strengthening of cooperation and integration of higher education system with industry. The project is conducted in cooperation between Faculty of Industrial Engineering Novo mesto and the company DONIT TESNIT d.o.o, which is one of the leading manufacturers of gasket sheets.

The proposed project deals with development of the manufacturing technology of a soft sealing material using the wet production process. Academic partner will, in cooperation with the company through the integration of students, contribute to solving the problem of quality control of seals.

Soft sealing materials are sheet materials used to create seals. Produced seals prevent leakage of liquid or gaseous medium from a closed system and at the same time protect the media from external contamination. Soft seals are used in pipeline joints when the media are transport fluids. They are used in flange systems, valves, pumps, compressors, internal combustion engines, heat exchangers, heating systems, etc.

During the production of the sealing material on a forming machine, a difference appears in the thickness of the wet layer which leads to technological losses. Quality control (inspection) of the thickness is performed manually at a specific time interval. Automation of the quality control process which measures the thickness of the sealing material will contribute to improving the market competitiveness of the company. Ultimately, the results of the project may contribute to solving ecological and environmental problems because the optimization of the manufacturing process may reduce harmful emissions into the atmosphere.

The project is being financially supported by the Ministry of Education, Science and Sport of the Republic of Slovenia, the European Union from the European Social Fund, and the Public Scholarship, Development, Disability and Maintenance Fund of the Republic of Slovenia within

the framework of the Programme for the implementation of the cohesion policy for period of 2014-2020.

Keywords: sealing materials, thin layer, quality control, automatization, production processes

Article Classification: Professional Paper

Razvoj dozirnega ventila za sisteme visokotlačnega peskanja

The Development of a Dosing Valve for High Pressure Sandblasting Systems

Gregor Kužnik & Anatolij Nikonov*

Fakulteta za industrijski inženiring Novo mesto | Faculty of Industrial Engineering Novo mesto

*anatolij.nikonov@fini-unm.si

kuznik.gregor@gmail.com

Povzetek

Peskanje je tehnološki postopek priprave ali čiščenja kovinskih ali nekovinskih površin za nadaljnjo obdelavo ter odstranjevanje korozije in utrjevanja kovinskih površin. Delo peskanja opravlja abrazivno sredstvo, ki v toku stisnjenega zraka pridobi veliko kinetično energijo ter zaradi svoje trdote in ostrorobe ali oglate oblike opravi delo. Tlačno peskanje, ki ga umeščamo med injektorsko in turbinsko peskanje, je bolj učinkovito od injektorskega ter manj energetsko potratno od turbinskega peskanja.

Postopek oz. tehniko tlačnega peskanja lahko uporabimo tudi kot način za utrjevanje kovinskih površin kjer je takšna aplikacija mogoča in želena. Tako za postopek tlačnega peskanja kot tudi za utrjevanje površin je nujno potrebna optimalna nastavitvev doziranja abraziva, da dosežemo optimalno porabo energenta in abraziva za želeno aplikacijo peskanja.

Dozirni ventil je ključna komponenta naprave za peskanje, ki omogoča nastavitvev doziranja količine abraziva v zračni tok. Vsi ventili so podvrženi obrabi, ki jo povzročata tok abrazivnega materiala. Obraba ventila je največja v procesu stika z abrazivom, kjer se pretok abraziva regulira in je zato tudi največji vzrok odpovedi ventila in zastojev dela.

Princip doziranja abrazivov skozi drsne površine niso dobra rešitev, ker abrazivni delci med dvema površinama pospešijo obrabo in odpoved funkcije doziranja. Nujno je, da je dozirni mehanizem zavarovan ali odporen pred obrabo ali vdorom abrazivnih delcev.

Razvit in izdelan je bil prototip oz. konstrukcija dozirnega ventila za sisteme tlačnega peskanja, ki omogoča združitev ročnega in avtomatskega tipa v samodejni tip, manjše število sestavnih delov ter čim natančnejše doziranje abrazivnega medija. Z eksperimentalnim postopkom so bile pridobljene karakteristike masnega pretoka skozi ventil v odvisnosti od nastavitve hoda odpiranja ventila. Meritve pretoka abraziva skozi ventil v odvisnosti od nastavitve hoda odpiranja ventila pri tlaku 4.5 bar so pokazale zelo stabilno delovanje ventila.

Ključne besede: tlačno peskanje, utrjevanje površin, dozirni ventili, abrazivni materiali, granulati

Abstract

Sandblasting is a technological process of preparation or purification of metallic or non-metallic surface for further processing and disposal of corrosion and hardening of metal surfaces. Sandblasting is carried out by abrasive materials, which obtain a lot of kinetic energy in a stream of compressed air. The abrasive material performs sandblasting due to its hardness and sharp-edged or square shapes. Pressure blasting, which is placed between the injector and turbine blasting, is more efficient than injector blasting, and less energy-consuming than the turbine blasting.

The technique of pressure blasting may also be used as a methodology for consolidating the metal surface where such an application is legitimate. Thus, the process of pressure blasting as well as the procedure of consolidating the surface requires the optimal setting of the abrasive dosage in order to achieve the optimal consumption of the energy source and the abrasive for desired blasting application.

The metering valve is a key component of the device for blasting, which allows setting the dosing quantity of the abrasive in the air stream. All valves are exposed to wear caused by abrasive material flow. Wear of the valve is significant in the process of contact with the abrasive, where the abrasive flow is regulated, and therefore is the biggest cause of valve failure and congestion of work.

The principle of abrasives dosage through the sliding surfaces is not a good solution because the abrasive particles between two surfaces accelerate wear and failure of dosing function. It is essential that the dosing mechanism is protected or resistant to abrasion or penetration of abrasive particles.

The prototype of the metering valve for pressure blasting systems was developed and manufactured. The developed valve enables the consolidation of both, the manual and the automatic type of valve, into the automatic type, as well as a smaller number of components, and more precise dosage of the abrasive medium. The performed experiments on the existing valve allowed us to obtain the characteristics of the mass flow through the valve as a function of the settled stroke of the valve opening. The measurements of the flow of abrasive through the valve as a function of the settled stroke of the valve opening at a pressure of 4.5 bar demonstrated very stable operation of the valve.

Key words: pressure blasting, surface hardening, metering valve, abrasive materials, granulates

Article Classification: Professional Paper

Electrospun Nanofibers. Energy and Environmental Applications

Rinat Mukhomodiarov* & Anatolij Nikonov

¹ Education and Research Institute of Nanostructures and Biosystems, Saratov State University

² Fakulteta za industrijski inženiring Novo mesto | Faculty of Industrial Engineering Novo mesto

*rinat2005@gmail.com

Abstract

Nanotechnology is one of the fields of science that effectively responds to the global energy and environmental related issues by designing and producing advanced functional materials proved their efficiency in a wide range of energy and environmental application. Electrospinning is currently the most effective technique that allows the production of nanofibers from polymers solved in water, acids or bipolar solvents as well as from melted polymers and is suitable for the production of organic and inorganic nanofibers. This versatile technology is easily adapted to a variety of process parameters for the optimization of the specific properties of the produced nanofibers. The key advantages include uniquely small fibre diameter as small as 30 nm, pore size of a few nanometres, continuous elastic fibres, using of any solvable polymer.

Saratov State University (SSU) being equipped with the full range of NanoSpider™ electrospinning machines, from the laboratory scale units to production scale equipment, focuses on research and development of advanced nanofiber materials. The "Advanced Materials" Innovative Technological Centre of SSU is fully capable to produce not only laboratory samples of the materials developed, but also pilot batches of roll nanofiber material. The most successful examples of such materials are presented as well as its applications in medicine, environment and energy areas.

Key words: nanotechnology, electrospinning, polymeric solutions, nanofibers, environmental application

Article Classification: Scientific Research Paper

Dejavniki konkurenčnosti

Competitive Advantage Factors

Kako učinkovito pregledati in ugotoviti stanje projekta

How to Quickly Review a Project Status

Tomaž Aljaž*

Spar Slovenija d.o.o.

Fakulteta za industrijski inženiring Novo mesto | Faculty of Industrial Engineering Novo mesto

*tomaz.aljaz@gmail.com

Povzetek

V večprojektnih okoljih je zelo težko na učinkovit način pregledati in določiti stanje projekta. Običajno se status projekta pregleda in poroča na projektnih mejnikih, ko projekt prehaja iz ene faze v drugo (npr. iz faze načrtovanja v fazo implementacije), časovno gledano to lahko traja od nekaj tednov do nekaj mesecev, odvisno od zahtevnosti in prioritete projekta ter internih pravil. Ni težko ugotoviti, da takšen način upravljanja projektov lahko povzroči neoptimalne prioritizacije projektov in posledično izvajalcev (virov) na projektu. Še več, če so zakasnitve na projektu večje (velike), potem so potrebne večje korekcijske aktivnosti kot npr. zmanjšanja obsega dela oz. funkcionalnosti ali je potrebno dodati dodatne izvajalce (vire) na projekt – povečati sredstva. Posledično to pomeni velik (negativni) vpliv na obstoječi portfolio projektov, saj je potrebno prerazporediti prioritete pri izvajalci (virih) in mogoče kratkoročno tudi odobriti delo izven običajnih delavnikov, da se ohranjajo dogovori za vpletene projekte. Zagotavljanje pogostejšega spremljanja stanja projekta/ov nam omogoča hitrejše reagiranje na nepredvidljive stvari v projektu in omogoča učinkovitejše upravljanje portfelja projektov.

Članek opisuje učinkovite metode pregleda stanja projekta, za različne metodologije projektnega vodenja, začenši s tradicionalnimi in v nadaljevanju z modernimi pristopi. Poseben poudarek bo na določitvi trenutnega stanja projekta, preostalih (ključnih) nalogah in soodvisnosti, še posebno morebitne soodvisnosti izvajalcev (virov). To nam bo omogočilo izvesti hitre korekcijske aktivnosti, če se bo zaznalo, da je vsebina, sredstva ali čas izvedbe projekta ogrožen.

Ključne besede: upravljanje projektnega portfelja, agilne metodologije, teorija omejitev, projektna metodologija kritične verige, scrum

Abstract

In a multi-project environment, it is very difficult to quickly determine the status of project. Traditionally, project status is reviewed at project milestone, in particular from one project phase to other, usually done at Steering Committee meetings, held in few months ratio. Clearly, this behaviour of managing projects, especially in multi-project environment, may

results in sub-optimal prioritization of project(s) and resource allocation. Even more, if major deliverables of project phase are delayed then significant corrective actions needs to be taken like reducing of scope of a project or putting more resources on a delayed deliverables / tasks. As a result, organizations operating in a multiple-project environment usually experience significant degradation in performance.

This paper outlines methods for quick project review for three widely used project management methodologies to improve the performance of project portfolio in organizations. It presents a simple and efficient approach to determine status of the remaining (critical) project tasks and interdependencies, involved resources, and identifies if project is on track or needs corrective actions to meet expectations of stakeholders and / or customers.

Keywords: Managing Project portfolio, Agile methodology, Theory of constraints, Critical Chain Project management, Scrum

Article Classification: Professional Paper

Multimodalni logistični center Novo mesto v fokusu gospodarstva Slovenije, osrednje in jugovzhodne Evrope

The Multimodal Logistical Center Novo mesto Focusing on the Economy of Slovenia for Central and South Eastern Europe

Sašo Murtič*

Fakulteta za industrijski inženiring Novo mesto | Faculty of Industrial Engineering Novo mesto

*saso.murtic@gmail.com

Povzetek

V zadnjih tridesetih letih se je na področju svetovnega gospodarskega razvoja zgodila revolucija, ki je globalno povezala svetovno industrijo, svetovni trg in velike mednarodne korporacije. Novi gospodarski premiki so na trg ponudili nove proizvode, izboljšano in posodobljeno tehniko in tehnologijo, obenem so se na trgu pojavili digitalizirani artikli, ki so pritegnili številne kupce in ki so spremenili postopke in pogoje gospodarskega razvoja. Spremenila se je oblika komuniciranja, povezovanja, prenosa podatkov in elektronskega poslovanja. Storjeni so novi premiki na področju gospodarskega medorganizacijskega povezovanja, medijske tehnologije in digitalizacije gospodarskih postopkov (Davidovič, 2000).

Avtomobilske industrije so uvedli robote v proizvodnjo, dizajnirali in oblikovali so nova, pojavila so se električna vozila. Na področju infrastrukture so organizirane nove pomorske poti, hitre železniške povezave in nove nizkocenovne letalske linije med celinami sveta. Ti premiki so tudi v Evropi zahtevali spremembe, ki so bile nujne in so vplivale na celotno gospodarstvo, predvsem so vplivali na razvoj železniške, letalske in pomorske infrastrukture. Povečanje menjave blaga, novi industrijski in tržni postopki so zahtevali posodobitev cestne, železniške in tudi letalske infrastrukture. Pojavil se je nov kontejnerski medcelinski transport, ki je zahteval hiter in velik razvoj pristanišč v obmorskih in rečnih krajih. Države so pričele boj kako in na kak način pridobiti kontejnerski tovor, ki je iz Kitajske in drugih vzhodnih držav prodiral v prostor Evrope. Obenem sta evropska elektronska in avtomobilska industrija iskala načine, kako in s kakšno ceno produktov prodati na vzhodne trge. Razvili so se veliki multimodalni logistični centri, ki so sprejemali blago ter izvajali logistične procese za naročnika, države so železnico in ceste priključevali v pomorske in rečne luke, gradili so letališča v neposredni bližini.

V naši bližini so zgradili velika pristanišča in v njih velike MMLC kot so Verona, Trst v Italiji, Zagreb, Reka in Zadar na Hrvaškem, Grac in Celovec v Avstriji itd. Ta spreminjanja so znanost in prakso prisilila v razmišljanja kje in kako znotraj Slovenije organizirati pretok blaga in kje umestiti multimodalne logistične centre. V članku bomo na makro in mikro ravni osvetlili multimodalni logistični center Novo mesto v fokusu gospodarstva Slovenije, osrednje in jugovzhodne Evrope.

Ključne besede: multimodalni, kontejnerizacija, digitalizacija, logistika

Abstract

On the field of world economic development over the last thirty years, development revolution happened, that connected world industry, global market and large international corporations. A market offered new products, improved and updated techniques, technologies and included new and previously unknown products, that attracted numerous customers and changed the rigid procedures in production and processes that are supporting production. New products changed the shape of communication, connecting, data transfer and electronic commerce. New moves were found out in the area of economic and inter-organizational integration and on field of media technology and digitalization of economic processes (Davidovic, 2000).

Large scientific steps have been implemented in the area of automobile industry, also robots are introduced into production. Industry designed and formed new and more modern vehicles and electric vehicles were developed. On field of infrastructure, new and fast rail links were built, in the airspace there are low cost transportation between continents of the world. There was an economic growth of China, India and other parts of the Eastern world, where new markets were opening up. Large expansion of products between continents, followed by the exchange of goods between Europe, Asia, America and other continents. There has been changes in the field of sustainable development, environmental protection and nature to population movements and general intercultural expansion. The rapid and complex changes can be attributed to the development of an economy, globalization of production and market, logistics and logistics processes. This is in many ways changed the course and development of the world, caused a number of movements in the context of market expansion and intercontinental connectivity. All these moves influenced infrastructure, transport and logistics. A new intercontinental container transport appeared which requested development of ports in coastal and river areas. A large multimodal logistics centers developed that were accepting goods, and that were carrying out logistical processes for a client. States were attaching railways and roads to the sea and river ports and were building airports in the immediate vicinity.

In the context of these developments, we have, through relevant and verified information looking for the possibilities for positioning of multimodal logistics centers in Slovenia and their integration in the region and outside of the Republic of Slovenia. We characterized Novo mesto as the economic most developed region in a state with surroundings and hypothesized that it was possible to place the modern logistics center, that would consider important role at execution of logistics and logistics processes for central and southeastern Europe in focus of the economy of Slovenia, to his place.

Keywords: multimodal, infrastructure, logistics and logistics processes, containerization, digitization, logistics platform.

Article Classification: Scientific Research Paper

Raziskave, razvoj, inovacije

Research, Development, Innovation

Razpoke zaradi toplotnega utrujanja na orodjih za tlačno litje aluminijevih zlitin

Thermal Fatigue Cracks on Aluminum Alloys Die Casting Dies

Mitja Muhič*

TPV d.o.o., Novo mesto

Višja strokovna šola, Šolski center Novo mesto | School Center Novo mesto, Higher

Vocational School

*muhic_mitja@yahoo.com

Povzetek

Orodja za tlačno litje lahkih kovin kot so aluminijeve in magnezijeve zlitine so izpostavljena visokim cikličnim temperaturnim in mehanskim obremenitvam ter zahtevnim kemijskim pogojem. Toplotne in mehanske obremenitve povzročajo visoke napetosti v materialu, ki posledično povzročijo lokalno porušitev materiala oziroma razpoke v materialu na površini orodja. V prispevku je predstavljano posredno opazovanje razpok na orodjih za tlačno litje z merjenjem napak na odlitkih, ki so posledica toplotnih razpok na površinah orodij. Toplotne razpoke so večje na in v bližini dolivka zaradi višjega pretoka vroče taline aluminijeve zlitine in na geometrijskih prehodih z majhnimi radiji, kjer so prisotne visoke koncentracije napetosti. Razpoke so večje – globlje v materialih z nižjo trdoto. Prve razpoke se na orodju lahko pojavijo že pred 2000 cikli tlačnega litja in se progresivno večajo z nadaljnjimi cikli.

Ključne besede: tlačno litje lahkih kovin, toplotno utrujanje, koncentracije napetosti, toplotne razpoke, napake na odlitkih

Abstract

Die casting dies for aluminum and magnesium alloys are exposed to high cyclic temperature and high mechanical loading. Thermal and mechanical loads cause high strain and stress in material and consequently local material fracture resulting in material cracking on die surface. This paper presents indirectly observation of cracks on die casting dies by means of measuring defects on aluminum alloy castings which are consequence of thermal cracks on die surfaces. Cracks due to thermomechanical fatigue occurred sooner and were bigger at the entrance of melt flow and in the areas of geometrical changes with small radiuses in which high stress concentrations are presented. Cracks were bigger – deeper in materials with lower hardness. First cracks on the die casting die surfaces appeared before 2000 die casting cycles and were growing in size with further cycles.

Keywords: Die casting, Thermomechanical fatigue, Stress concentration, Thermomechanical cracks, Casting defects

Article Classification: Scientific Research Paper

Krhki lom in odklon razpoke v heterogenih zvarih jeklenih rezervoarjev

Brittle Fracture and Crack Path Deviation at Heterogeneous Steel Welds of Storage Tanks

Zdravko Praunseis*

Univerza v Mariboru | University of Maribor
Fakulteta za energetiko | Faculty of Energy Technology
*zdravko.praunseis@um.si

Povzetek

Varjenje visokotrdnostnih mikrolegiranih jekel (VTML) pri gradnji nizkotrdnostnih zvarnih spojev še vedno predstavlja tehnološki izziv za moderne varjene konstrukcije. Pri tem je potrebno paziti na dosežen nivo trdnostne neenakosti zvarov, ki morajo biti grajeni z dovolj žilavim dodajnim materialom (žica, elektroda) in ustrezno izbrano tehnologijo varjenja. Zvar z visoko žilavostjo bo sposoben prenesti visoke plastične deformacije in preprečiti krhki lom. Pomembno je, da pri gradnji VTML zvarov preprečimo možnosti nastanka ploskovnih napak (razpokljivost v hladnem, zlepljena mesta, itd.) in lokalno krhkih področij (LKP), ki lahko povzročijo zlom konstrukcije.

Namen raziskave je določitev CTOD lomne žilavosti v treh nizkotrdnostnih zvarnih spojih z uporabo standardnih procedur.

Ključne besede: VTML jekla, krhki lom, odklon razpoke, lomna žilavost, rezervoarji

Abstract

Welding of a high-strength low-alloyed (HSLA) steel with the aim to produce an undermatched weld joint presents a technological challenge for modern welded structure production. One should pay attention to the level of strength mismatching which should provide sufficient toughness of the weld metal by using an appropriate welding consumable (wire, electrode) and welding procedure. High toughness of weld metal is necessary to enable local plastic deformation and to prevent brittle fracture. It is of utmost importance to exclude the possibility of plane faults (hydrogen cracking, lack of fusion, etc.) and local-brittle-zone (LBZ) appearance in HSLA steel undermatched welded joints, which can cause failure.

The aim of this research was to estimate the weld metal Crack Tip Opening Displacement (CTOD) fracture toughness using standard procedures for three differently undermatched welded joints.

Keywords: HSLA steels, brittle fracture, crack path deviation, fracture toughness, storage tanks

Article Classification: Scientific Research Paper

Comparison of a Single-Stage Cycle Heat-Pump and a Single-Stage Cycle Heat Pump with Internal Exchangers

Róbert Sánta*¹ & Igor Fürstner²

¹ University of Dunaújváros, Hungary (Madžarska)

² Óbuda University, Hungary (Madžarska)

Subotica Tech - College of Applied Science

*santa.robert@uniduna.hu

furstner.igor@bgk.obuda-uni.hu

Abstract

The presented research focuses on the comparison of a single-stage cycle heat-pump and a single-stage cycle heat pump with internal exchangers, investigating the thermodynamic and heat transfer processes of the heat-pumps' cycles. The investigation is performed by establishing the mathematical models using algebraic equations. The numerical investigation takes into consideration the influence of the evaporation and condensation temperatures on the heat-pumps' coefficients of performance, as well as on the compression powers, the mass flow rates of the cooling medium, and the heating capacities of both heat-pump systems. The simulation program is based on steady state mathematical models of the refrigeration circuits, including the compressors, heat exchangers and thermostatic expansion valves. The numerical investigation is performed by using commercial software.

Key words: Heat pump, mathematical modell, simulation, internal heat exchanger, COP

Article Classification: Scientific Research Paper

Zasnova laboratorijskega modela sotočja rek Krke in Save

Design of a Laboratory Model of Confluence of Rivers

Gorazd Hren*, Andrej Predin, Matej Fike & Marko Pezdevšek

Univerza v Mariboru | University of Maribor

Fakulteta za energetiko | Faculty of Energy Technology

*gorazd.hren@um.si

andrej.predin@um.si

matej.fike@um.si

marko.pezdevsek@um.si

Povzetek

V članku je obravnavano področje hidravličnega modeliranja. Gradnja hidroelektrarn na spodnji Savi spreminja hidravlični model reke Save in njenih pritokov. Fizični hidravlični modeli so vsled razlike med naravno velikostjo in velikostjo prototipa nujno podvrženi velikemu vplivu modelnega merila, ki z brezdimenzijskimi koeficienti usklajuje porušena razmerja med geometrijskimi in hidravličnimi veličinami. Analizirali smo vpliv modelnih velikosti na fizičnem prototipu sotočja rek Krke in Save in jih primerjali z numeričnim modelom.

Ključne besede: hidravlični model, sotočje, eksperiment, modelno merilo, CFD

Abstract

In this paper, the field of the hydraulic modelling is discussed. The recent implementation of hydro power plants in Sava River is changing the hydraulics model of the river and tributary Krka. We have prepared the physical prototype, which differs between natural and experimental size of the model. The broken relationship between physical and experimental size is solved with dimensionless coefficients to establish correct relations between geometrical and hydraulic model values on the prototype. We have analysed the impact of model coefficients on physical prototype of confluence between rivers Sava and Krka with the numerical model.

Keywords: hydraulic model, confluence, experiment, benchmark model, CFD

Article Classification: Professional Paper

Patient-Specific Finite Element Analysis to Assess the Surgical Success in the Lumbosacral Region of the Spine

Leonid Kossovich*, Irina Kirillova, D. Ivanov & A. Dol

Education and Research Institute of Nanostructures and Biosystems, Saratov State University

*president@sgu.ru

Abstract

Damage of the spine is one of the severe diseases of human musculoskeletal system. The quality of medical care can be significantly improved if, in planning the stages of reconstructive intervention, take into account not only the anatomical, topographic, structural, but also biomechanical characteristics of various elements of the spine, as well as the mechanical and structural features of the implants.

Biomechanical modeling of the spine, fixation systems and implants is most often carried out using the finite element method (FEM). FEM allows to analyze not only the healthy spine and its segments, but also diseased and injured spines, including various vertebral fractures of spine, different types of dorsopathies, osteopathies and chondropathies.

Biomechanical modeling of three variants of surgical treatment of a specific patient with a diagnosis of antespondilolisthesis of one of the vertebrae was performed. It was revealed that all three variants of surgical treatment considered will give satisfactory results, but the most optimal in terms of axial and rotational stability is the fixation of vertebrae L4-S1 with six transpedicular fixators and two rods.

Key words: spine, FEM, biomechanical modeling, vertebral fracture, surgical treatment

Article Classification: Scientific Research Paper

Primerjava tlačnih izgub v kotlovskih delilnikih

Comparison of pressure losses in boiler manifolds

Matej Fike* & Marko Pezdevšek

Univerza v Mariboru | University of Maribor
Fakulteta za energetiko | Faculty of Energy Technology

*matej.fike@um.si

marko.pezdevsek@um.si

Povzetek

Energetska učinkovitost ima za zagotavljanje ciljev energetske politike in širših razvojnih ciljev države, zlasti zaradi potenciala za izboljšanje konkurenčnosti družbe, zelene rasti in zaposlitvenega potenciala, izjemen pomen. Z namenom povečanja energetske učinkovitosti ogrevalnih sistemov smo analizirali tlačne izgube v kotlovskih delilnikih. Izvedene so bile meritve tlačnih padcev v odvisnosti od pretoka za tri oblikovno različne vendar funkcionalno enake delilnike. Da se pri iskanju optimalne oblike delilnika izognemo dragim laboratorijskim meritvam, za katere je potrebno predhodno izdelati prototipe, smo izvedli tudi numerične simulacije in rezultate simulacij primerjali z meritvami.

Ključne besede: energetska učinkovitost, kotlovski delilniki, tlačni padec, meritve, numerične simulacije

Abstract

Energy efficiency is very important in order to ensure the objectives of energy policy and broader development goals of the country, especially due to the potential for improving competitiveness, green growth and employment potential. In order to increase the energy efficiency of heating systems, the pressure losses in the boiler's manifolds were analysed. Experimental measurements of pressure drop as a function of flow rate for three-dimensionally different but functionally the same manifolds were carried out. To find the optimal shape of manifold and to avoid expensive laboratory measurements, which require manufacturing of prototypes, numerical simulations were performed, and results were compared with measurements.

Key words: energy efficiency, boiler manifolds, pressure drop, measurements, numerical simulations

Article Classification: Scientific Research Paper

Vpliv polnila pri 3D tiskanju na upogibno trdnost

Effect of Infill Density of 3D Printing on Flexural Strength

Marko Pezdevšek*, Matej Fike & Gorazd Hren

Univerza v Mariboru | University of Maribor

Fakulteta za energetiko | Faculty of Energy Technology

*marko.pezdevsek@um.si

matej.fike@um.si

gorazd.hren@um.si

Povzetek

Tehnologija 3D tiskanja hitro napreduje, cena tiskalnikov se je z leti znižala na dostopno raven in 3D tiskalniki počasi a vztrajno prodirajo v naš vsakdan. Za namen tega prispevka smo za tiskanje uporabili tiskalnik Type A Machines Series 1. Tiskalnik deluje na tehnologiji ciljnega nalaganja in omogoča tiskanje različnih polimerov. Naredili smo primerjalno analizo med polnim modelom in modeli z različno gostoto polnil. Izvedli smo numerične simulacije in rezultate primerjali z rezultati standardnega upogibnega testa ter preverili vpliv polnila na upogibno trdnost, saj z manjšo gostoto polnila prihranimo tako pri materialu, kar posledično pomeni manjši strošek, kot pri času tiskanja.

Ključne besede: 3D tiskanje, upogibni preizkus, primerjalna analiza, FDM, numerične simulacije

Abstract

3D printing is advancing at a high pace, over the years the price has dropped down to a relatively accessible level and 3D printers are steadily becoming a part of our educational and manufactural process. For the purpose of this paper Type A Machines Series 1 3D printer was used. The aforementioned 3D printer utilises fused deposition modelling technology to manufacture a 3D model. In this paper, we investigated the effects of different infill densities on flexural strength. Models with different infill densities were printed and subjected to a standardised bending test. The results were compared with numerical simulations done in SolidWorks Simulation.

Keywords: 3D printing, bending test, comparative analysis, FDM, numerical simulations

Article Classification: Professional Paper

Preučevanje stabilnosti strukture polisaharidov z reološkimi metodami

Rheological Examination of Polysaccharide Structure Stability

Valentina Rebec¹, Igor Plazl¹, Urška Florjančič² & Anatolij Nikonov*²

¹ Univerza v Ljubljani | University of Ljubljana

Faculty of Chemistry and Chemical Technology | Fakulteta za kemijo in kemijsko tehnologijo

² Fakulteta za industrijski inženiring Novo mesto | Faculty of Industrial Engineering Novo mesto

*anatolij.nikonov@fini-unm.si

Povzetek

Članek avtorji posvečamo pred letom in pol umrli slovenski raziskovalki dr. Andreji Zupančič Valant, ki je večji del svojega strokovnega dela posvetila reologiji. Pričujoče delo se je začelo pod njenim mentorskim vodstvom, nadaljevalo pa žal brez nje.

Polisaharidi so naravni polimeri ali biopolimeri, ki imajo širok spekter uporabe zaradi sposobnosti spreminjanja lastnosti njihovih raztopin z zgoščevanjem, želiranjem, emulgiranjem, stabilizacijo, enkapsulacijo, flokulacijo, nabrekanjem in nastankom gelov. Pogosto se uporabljajo v industrijskih panogah kot so prehrambna, kemična, farmacevtska, kozmetična, tekstilna industrija, industrija premazov in nafte, v medicini in drugje. Na vseh omenjenih področjih je bistvenega pomena struktura samega izdelka, ki je v veliki meri vezana na mehanske oz. reološke lastnosti samega materiala.

V praksi je pogosto pomembno vprašanje, kako staranje materiala vpliva na njegove lastnosti in posledično na končno funkcionalnost izdelka. V raziskavi smo se osredotočili na preučevanje gelov, in sicer gellana, welana in ksantana, ter polimernih raztopin: hidroksipropilmetilceluloze in natrijeve karboksimetilceluloze. V ta namen so bile izvedene tokovne meritve, amplitudne in frekvenčne meritve, testi lezenja in obnove ter ponavljajoči testi lezenja in obnove, vse pri istih začetnih pogojih. Staranje materialov smo preučevali z meritvami, ki so bile izvedene na vseh preiskovanih vzorcih po 20-ih, 60-ih in 140-ih dneh.

Meritve so pokazale, da imata polimerni raztopini hidroksipropilmetilceluloza in natrijeva karboksimetilceluloza bolj viskozen značaj v primerjavi z gellanom, welanom in ksantanom, ki izkazujejo bolj izrazite elastične lastnosti. Iz rezultatov staranja vzorcev je bilo ugotovljeno, da se v primeru welana, ksantana, hidroksipropilmetilceluloze in natrijeve karboksimetilceluloze rezultati meritev po 20-ih, 60-ih in 140-ih dneh ne razlikujejo od začetnih meritev. To pomeni, da se struktura materialov po 140-ih dneh ne spremeni in ostanejo reološke lastnosti enake. Ravno nasprotno velja za vzorec gellana, kjer so eksperimentalni podatki pokazali, da struktura gellana s časom postaja vedno bolj elastična.

Ključne besede: reologija, polisaharidi, polimerna raztopina, gel, lezenje, staranje

Abstract

Authors dedicate this paper to Slovenian researcher Dr. Andreja Zupančič Valant, who passed away a year and a half ago. Her main research interest was rheology and she significantly contributed to development of rheological studies in Slovenia. The present work started under her supervision, but unfortunately continued without her.

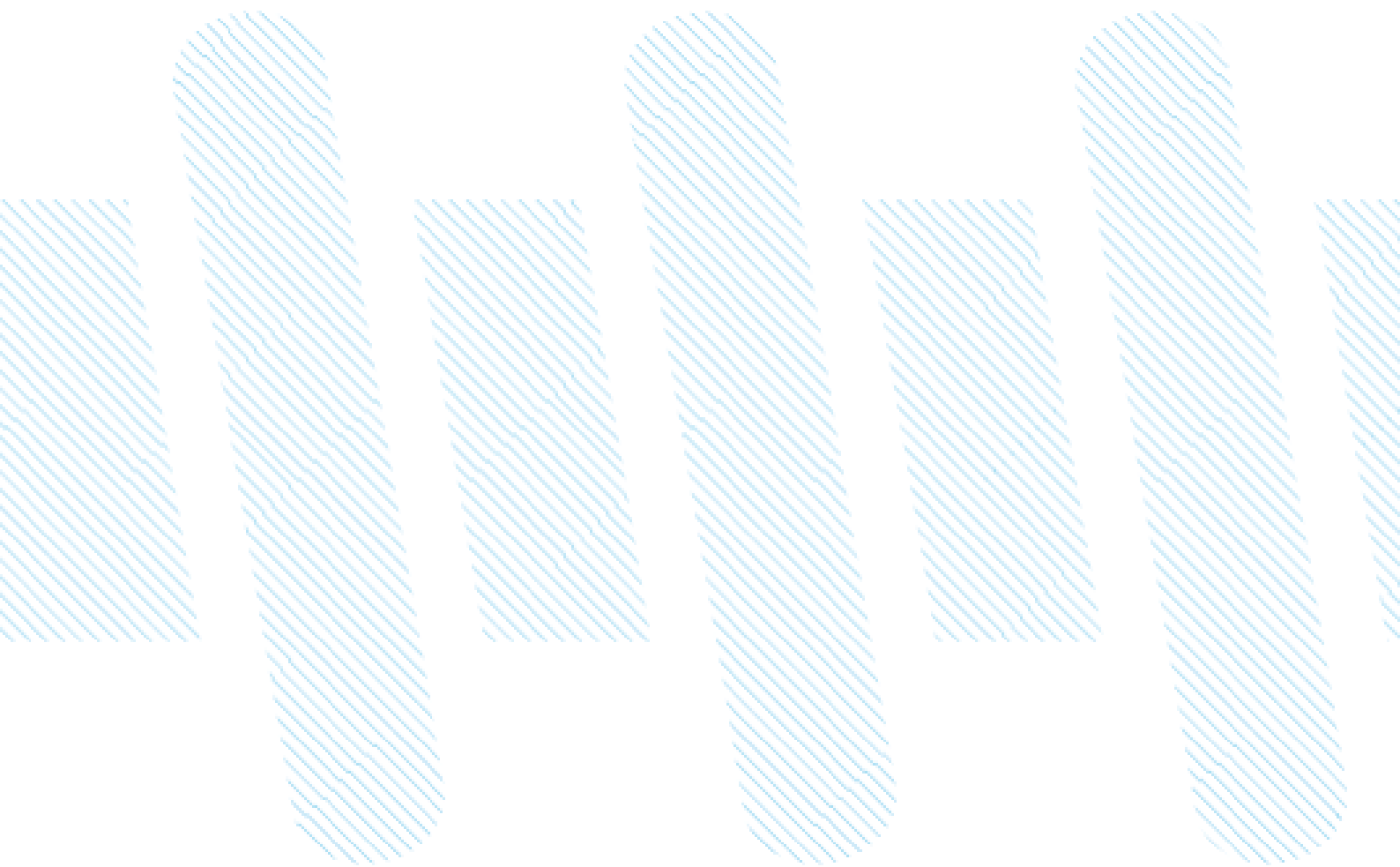
Polysaccharides are natural polymers or biopolymers with broad spectrum of usage due to their capability of modifying the solution properties by thickening, gelation, emulsification, stabilization, encapsulation, flocculation, swelling and gel formation. They have many industrial applications, for example in food, chemical, pharmaceutical, cosmetic, textile, paint, oil industry, medicine and much more. For all of these applications the key parameter to manipulate is the product structure which mainly influences the mechanical and rheological properties of the material.

In practice a very important question is how the aging of material influences its properties and consequently the functionality of the final product. We focused our research in investigation of five biopolymers dissolved in water, forming gels, i.e., gellan, welan and xanthan, and polymer solutions such as hydroxymethylcellulose and sodium carboxymethylcellulose. For this purpose we made flow curve testing, amplitude and frequency measurements, and periodic creep and recovery tests, all of them at equal initial conditions. The aging of materials was examined by performing tests with investigated samples after 20, 60 and 140 days.

The measurements showed that polymer solutions of hydroxymethylcellulose and sodium carboxymethylcellulose exhibit more viscous behavior than gellan, welan and xanthan water solutions, showing elastic properties. The aging testing revealed that the results of measurements for welan, xanthan, hydroxymethylcellulose and sodium carboxymethylcellulose after 20, 40 and 140 days don't differentiate from the results of initial measurements. It means that the structure of these materials doesn't change after 140 days and the rheological properties remain unmodified. On the contrary, the experimental results for gellan showed that its structure becomes gradually more elastic while time progresses.

Key words: rheology, polysaccharide, polymer solution, gel, creep, aging

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