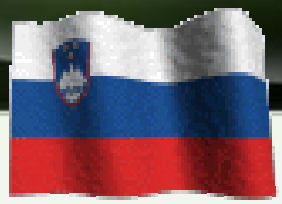
UNAPREĐENJE REGIONALNE NAUČNO ISTRAŽIVAČKE SARADNJE REPUBLIKE SLOVENIJE I BOSNE I HERCEGOVINE



NAUČNO-ISTRAŽIVAČKA I RAZVOJNA SARADNJA IZMEĐU FAKULTETA, INSTITUTA I INDUSTRIJE

Raziskovalno in razvojno sodelovanje fakultete, instituta in industrije

Research and development cooperation between faculty, institute and industry

Borut Kosec

University of Ljubljana
Faculty of Natural Sciences and Engineering
Ljubljana, Slovenia

Zenica, 19. 12. 2012

University of Ljubljana
is an institution with a very rich tradition.

It was established in 1919 on the foundations of long-established pedagogical tradition.

Univerza *v Ljubljani*

1919

24 Faculties
3 Academies

approx. 52.000 graduate and post-graduate students
approx. 3.500 teaching and research staff
approx. 900 technical and administrative staff

www.uni-lj.si

UNIVERZA V LJUBLJANI

WEBOMETRICS (2012)

(www.webometrics.info)

University of Ljubljana

106th position in the World

23th position in Europe

University of Ljubljana
Faculty of Natural Sciences and Engineering
Department of Materials Science and Metallurgy
Aškerčeva cesta 12, 1000 Ljubljana, Slovenia

Faculty of Natural Sciences and Engineering

www.ntf.uni-lj.si

Department of Geology

Department of Mining

Department of Textile and Graphic Engineering

Department of Chemical Engineering

Department of Materials Science and Metallurgy

Department of Materials Science and Metallurgy

6 chairs

Engineering materials

Foundry

Metal processing technology

Metallography

Metal forming

Thermal technics

Education programmes at

University of Ljubljana
Faculty of Natural Sciences and Engineering
Department of Materials Science and Metallurgy

B. Sc. education programmes
Metallurgical Technologies
Engineering Materials

M. Sc. education programme
Metallurgy and Materials

Ph.D. education programme
Materials Science

Interdisciplinary Ph.D. university education programme
Environmental Protection

Projects:
SLOVENIAN RESEARCH AGENCY (2005 –)

SLOVENIAN RESEARCH AGENCY

Code	Project Title	Duration
L2-3496	Synthesis of Composite Materials and Compounds with high Energy Rate	1.7.2002 - 30.6.2005
L2-5078	The development of a new technology of silver bands production	1.1.2003 - 31.12.2005
L2-5262	Study of the increase of penetration depth in tig welding of stainless steel	1.1.2003 - 31.12.2004
L2-6313	Optimisation of the manufacturing technologies of steel semiproducts for the automotive industry	1.7.2004 - 30.6.2007
L2-6342	Superplasticity of Al-Mg and Al-Zn-Mg-Cu alloys with scandium addition	1.7.2004 - 30.6.2007
L2-7096	The development of new dental alloy with high Au-content	1.9.2005 - 31.12.2008
M2-0108	New shape memory metal alloys	1.6.2006 - 31.5.2010
L2-4183	Friction stirr welding of Al alloys	1.7.2011 - 31.6.2014

International cooperation (2005 –)

EUREKA E!2982 COMBUB
The Strengthening Effect of Nano-Sized Bubbles in a Metal Matrix for the Prediction of Strengthened Composites (1.12.2002 – 1.11.2005)

BI SLO – CZ (SLO-CZ 05/06-014)
Optimization of technological parameters of the heavy gravity cast rolls from ductile cast iron for rolling rails (1.1.2005 – 31.12.2006)

EUREKA E!3704 RSSMA
Rapidly Solidified Shape Memory Alloys (1.1.2006 – 30.11.2008)

EUREKA E!3863 MET-STRI
The new Approach of Strengthening Technology for Metallic Strips used for Electro Industry (1.9.2006 – 31.12.2009)

TEMPUS IB_JEP-41156-2006 (RS) TIMEA
Training of Institutions in Modern Environmental Approaches and Technologies (1.9.2007 – 31.01.2010)

BI SLO – PL (SLO-PL 08/09-023)
Physical and Chemical modelling of Metallurgical Processes (1.1.2008 – 31.12.2009)

BI SLO – BiH (BI-BA 08/09-002)
Heat Treatment Optimisation of Steel Semi-Products for Automotive Industry (1.1.2008 – 31.12.2009)

EUREKA E!4213 NANO-FOIL
Development of Nano-Foils for Dentistry and Jewellery (1.5.2008 – 1.1.2011)

BI SLO-CRO (SLO-HRV 09/10-023)
Development of new metallic materials with shape memory effect (1.1.2009 – 31-12.2010)

BI SLO-PL (SLO-PL 09/10-002)
FSW of hard to weld cast aluminium alloys and magnesium alloys (1.1.2009 – 31.12.2010)

BI SLO – BiH (BI-BA 10/11-011)
New Materials for Automotive Industry (1.1.2010 – 31.12.2011)

BI SLO – CG 201072011-5
Improvement of environmental management system using multisoftware (1.1.2010 – 31.12.2012)

TEMPUS 510985-TEMPUS-1-2010-1-RS-TEMPUS-JPHES (2 010 - 3366 / 001 - 001) ISIS
Trans-European Cooperation Scheme for Higher Education (15.10.2010 – 14.10.2013)

BI SLO – CG (SLO-CG 12/13-014)
Development of high-strength aluminium alloys reinforced with quasicrystals (1.1.2012 – 31.12.2013)

BI SLO – ZDA (SLO-ZDA 12/13-026)
Nanontensile tests and HREM of deformation mechanisms in quasicrystalline alloys (1.1.2012 – 31.12.2013)

BI SLO – CRO (BI-HR 12/13-038)
Manufacturing technologies and heat treatment processes of steel semiproducts for automotive industry (1.1.2012 – 31.12.2013)

ERA NET
New metallic materials and characterization methods (1.6.2011 – 30.5.2014)

EUREKA E!6735 ESPAL
Energy Savings by application of Electromagnetic Field in production of Al-alloy billets by DC casting method (1.4.2011 – 1.4.2013)

Cooperation with the foreign universities / institutes in the fields of research and education

Technische Universitaet Leoben, Leoben, A
Technische Universitaet Wien, Wien, A
Technische Universitaet Clausthal, Clausthal, D
Universitat Politecnica de Catalunya, Barcelona, E
Technical University of Brno, Faculty of Mechanical Engineering, Brno, CZ
Silesian University of Technology, Gliwice, PL
Technical University Krakow, Krakow, PL
University of Osaka, Osaka, J
University of California, Berkely, USA
Univerzitet u Novom Sadu, Fakultet Tehničkih Nauka, Novi Sad, SR
Univerzitet u Beogradu, Beograd, SR
Univerzitet u Zenici, Zenica, BiH
Univerzitet u Banja Luci, Mašinski fakultet, Banja Luka, BiH
Sveučilište u Zagrebu, Metalurški fakultet, Sisak, CRO
Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, CRO
Univerzitet Crne Gore, Podgorica, CG
Universita di Trieste, Trst, I

Metalurški institut Kemal Kapetanović, Zenica, BiH
VTI Vojno tehnički institut, Beograd, SRB

Cooperation with industrial partners

Acroni d.o.o., Jesenice
Metal Ravne d.o.o., Ravne
Štore Steel d.d., Štore
Iskra Avtoelektrika d.d., Šempeter
Impol d.d., Slovenska Bistrica
Cimos d.d., Koper
Talum d.d., Kidričevo
ETI Elektroelement d.d., Izlake
Kolektor d.d., Idrija
Rotomatika d.d., Sp. Idrija
Inductio d.o.o., Ljubljana
MLM d.d., Maribor
Metaling d.o.o., Ljubljana
Terming d.o.o., Ljubljana
BACO d.o.o, Trzin
KOVA d.o.o., Celje
Klima d.d., Godovič
Bosio d.o.o., Štore
Ydria Motors d.o.o., Cerknica
Akrapovič d.o.o., Ivančna Gorica
Kovinarstvo d.o.o., Vitanje
Zlatarna Celje d.d, Celje


REPUBLIKA SLOVENIJA

PATENT

21705

ECO Klima GmbH, Wien
Treibacher Auremet GmbH, Treibach
Tomeks a.d., Prijedor / Ljubija
SaMax d.o.o, Banja Luka
Bosio Zenica d.o.o., Zenica
TEM Inženjering d.o.o., Banja Luka
U.S. Steel, Košice
Zlatna Aurora d.o.o., Sisak
EXOR d.d., Buzin


Beschussamt Ulm

Zertifikat - Certificate

S 12 0009 12 / Z

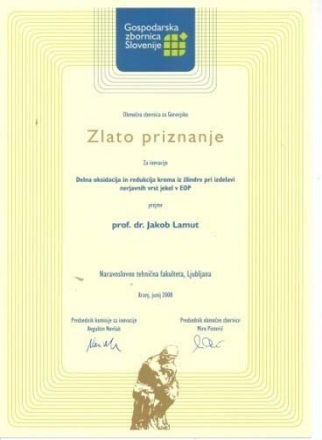
Durchschusshemmendes plattenartiges Material

Bullet resistant plate materials


Gospodarska zbornica Slovenije

Srebrno priznanje

Jure Bernetič


Gospodarska zbornica Slovenije

Zlato priznanje

prof. dr. Jakob Lamut

ACS Slovenian Automotive Cluster
Slovenian Plasttechnics Cluster
Slovenian Steelmaking Platform
Center of Excellence: Advanced Metallic Materials
SICOS – Court Experts

Industrial projects (2005 –)

Ecologically sound materials for fussible elements of low voltage fuses
ETI d.d. - UL Faculty of Natural Sciences and Engineering

Development, Know-How and Technologies for Production of Foils Made by Continuously Cast Strip on the Base of AA8079 Aluminium Alloy
UL Faculty of Natural Sciences and Engineering - Impol d.d.

Development of wear resistant structural steel
ACRONI d.o.o. – UL Faculty of Natural Sciences and Engineering

Temperature calibration of furnace for heat treatment of Al alloys castings for the automotive industry
Cimos d.d. - UL Faculty of Natural Sciences and Engineering

Heat treatment of steel semi-products for the automotive industry
Iskra Avtoelektrika d.d. - UL Faculty of Natural Sciences and Engineering

Optimisation of the inductive heating and quenching of planetary shafts
Iskra Avtoelektrika d.d. – UL Faculty of Natural Sciences and Engineering – TERMING d.o.o.

Optimisation of mechanical properties of Inconel 718 with heat treatment
Rotomatika d.d. – UL Faculty of Natural Sciences and Engineering

Deformation of superplastic Al alloys
Impol d.d. - UL Faculty of Natural Sciences and Engineering

Foundry total waste management
KOVA d.o.o. - UL Faculty of Natural Sciences and Engineering

Development of new dental alloys
UM Faculty of Mechanical Engineering - Zlatarna Celje d.o.o.- UL Faculty of Natural Sciences and Engineering

Continuous tinning of Cu ribbons
Kolektor d.d. - Ul Faculty of Natural Sciences and Engineering

Field(s) of research

Department of Materials Science and Metallurgy

Synthesis and characterisation of materials (metalls, cheramics, polymers and composites).

Failure and Fracture analysis. Expert work.

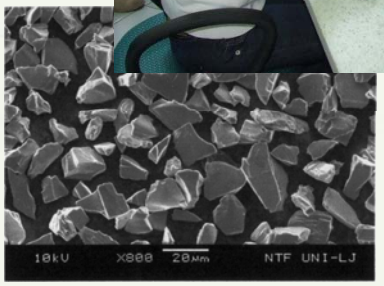
Microscopy. OM. SEM.

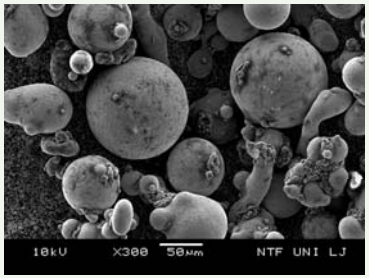
Modelling (experimental, mathematical, numerical).

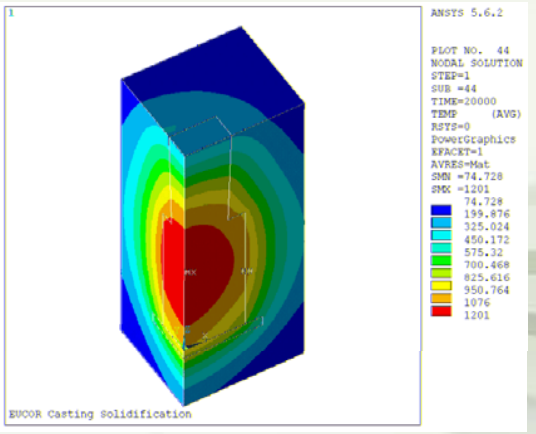
(Micro)hardness measurements, measurements of carbon and sulphur content.

DTA and STA materials analysis.

Thermal and thermochemical treatment of metallic materials.







Field(s) of research

Department of Materials Science and Metallurgy

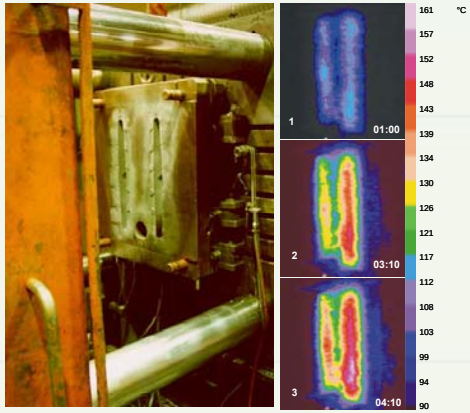
Foundry. Die casting.

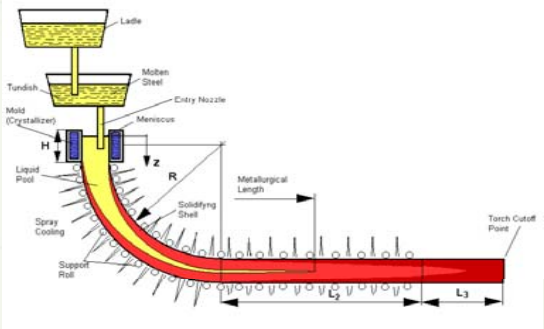
Steelmaking. Continuous casting.

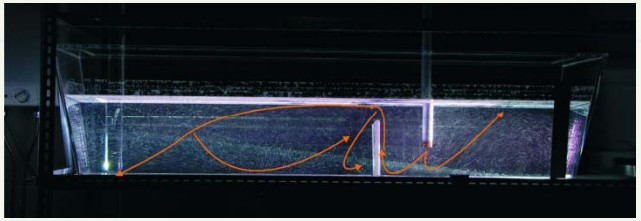
Engineering measurements.

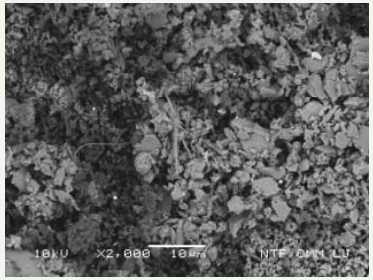
Ecology. Materials recycling. Designing Environmentally-Fiendly Products and Technologies.

Production of high-speed solidified materials (amorphous materials, Al and Cu based alloys, composites, shape memory alloys).

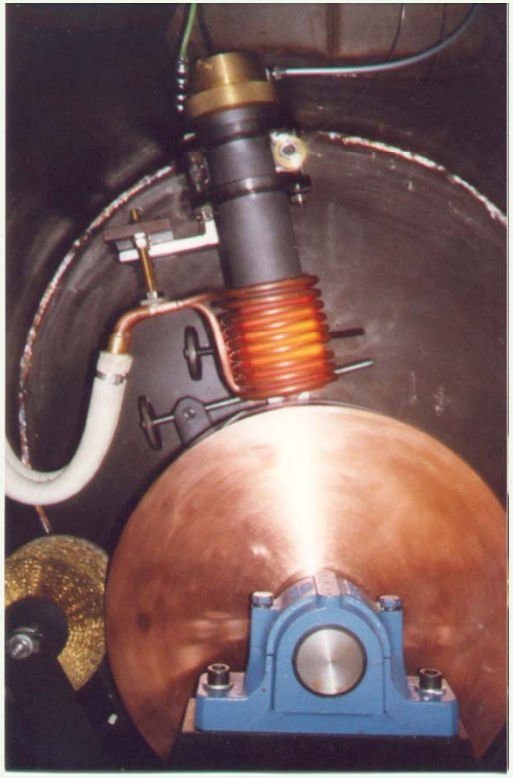


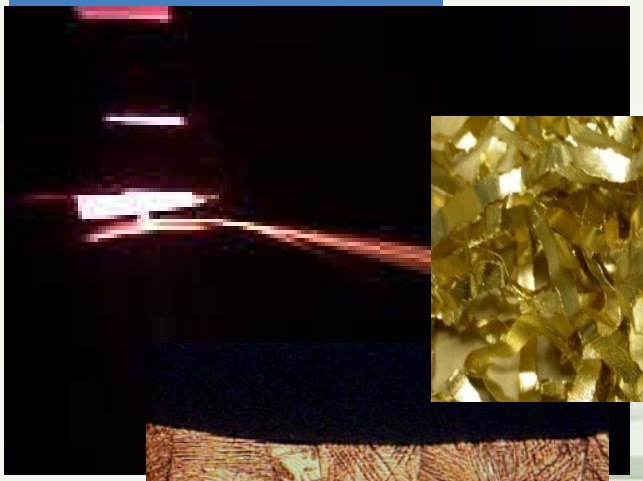


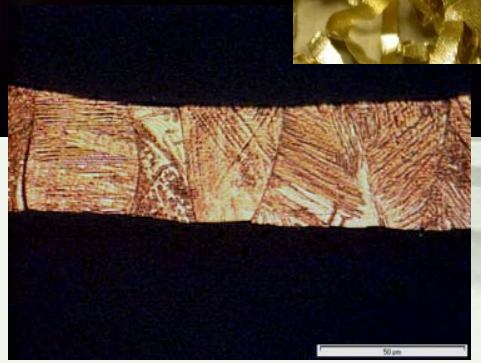




Melt spinner







Rapidly solidified shape memory alloys

Cu-Al-Ni

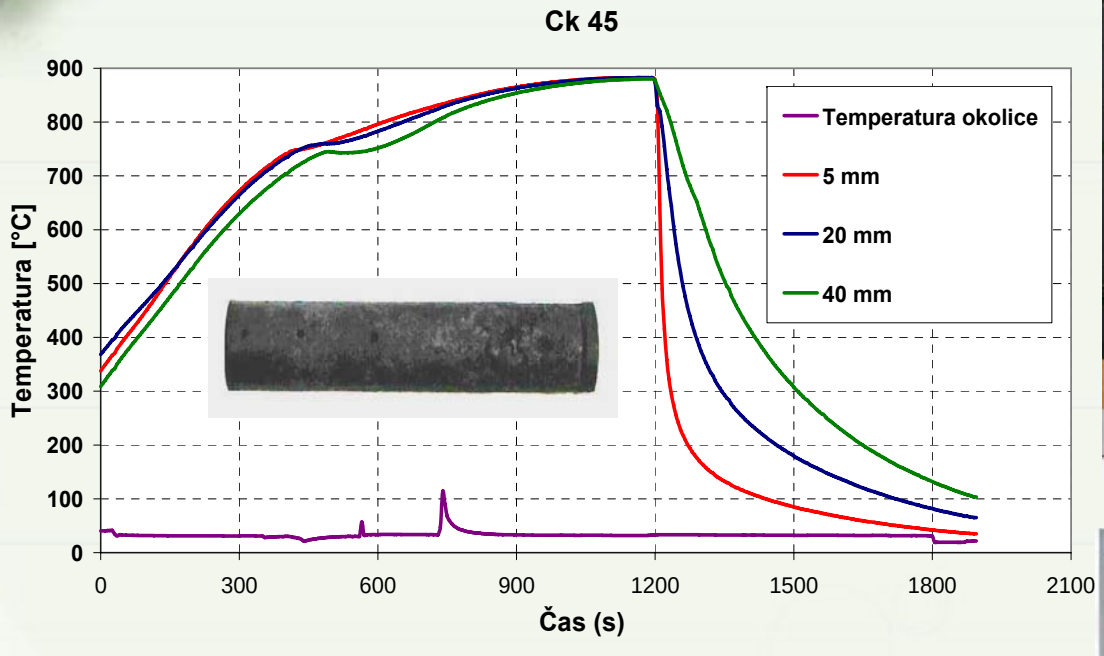
Cu-Al-Ni-B

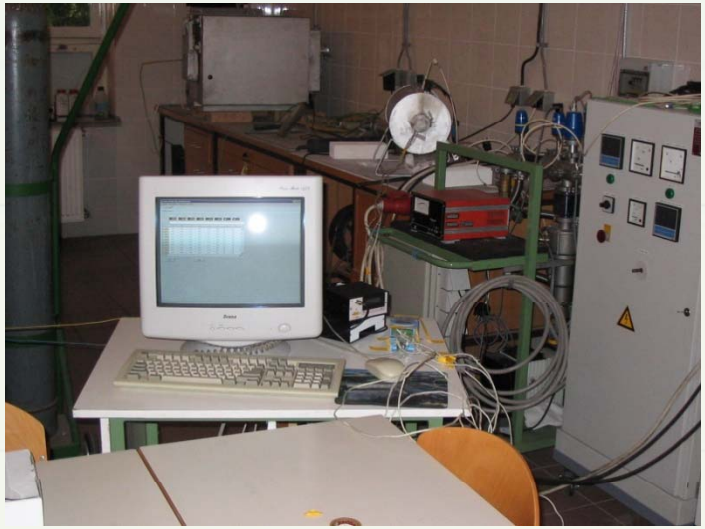
Cu-Al-Zn-Ni

E!2982 COMBUB
1.12.2002 – 30.11.2005

E!3704 RSSMA
1.1.2006 – 31.12.2009

Hardenability testing system

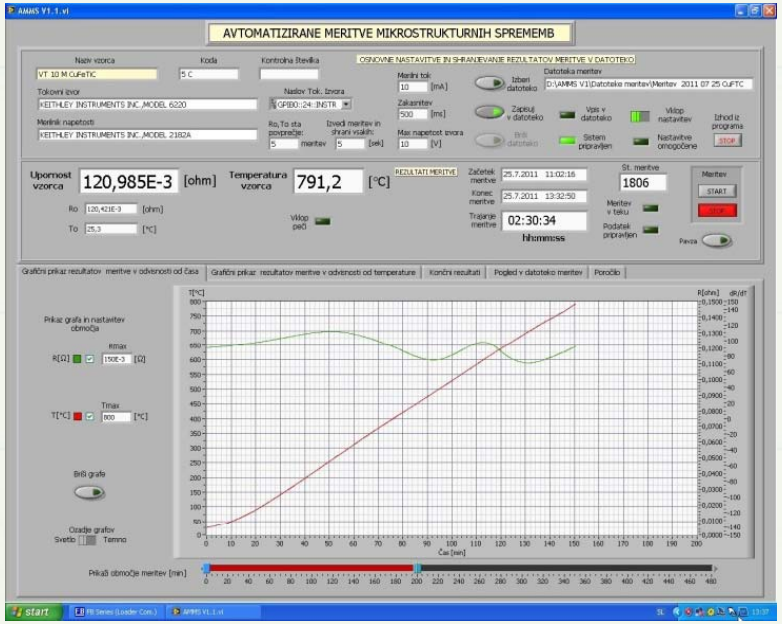




In Department for materials and metallurgy, Faculty of Natural science and engineering, University of Ljubljana, we have testing hardenability of various steels that are needed in Slovenian and foreign industry.
Existent system consisted of electrical furnace in which testing samples are heated on an austenitization temperature and quenching bath that with a jet of water cools down the head surface of a testing sample. For cooperative needs for industry the upgrade of a current system was made including a system that enables continuous measurements of temperature of a testing sample during a whole experiment.

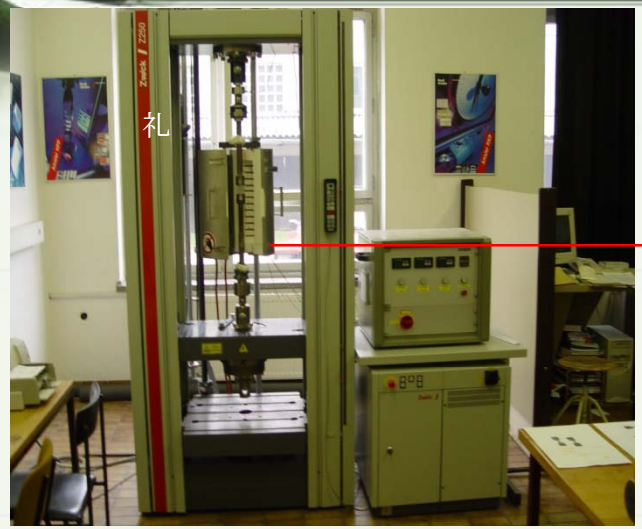
Device for measurement microstructural changes

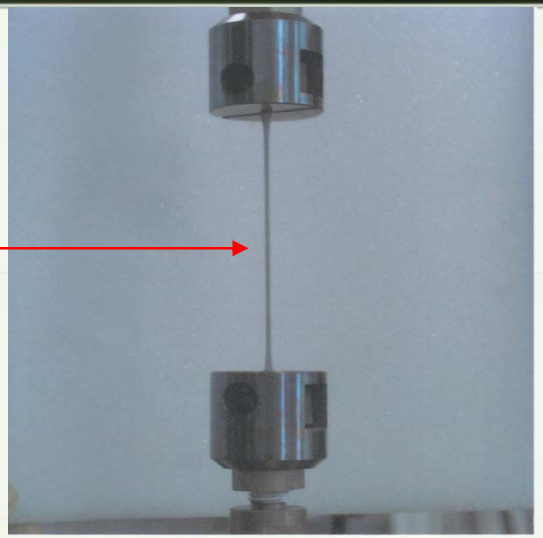
Measurning system



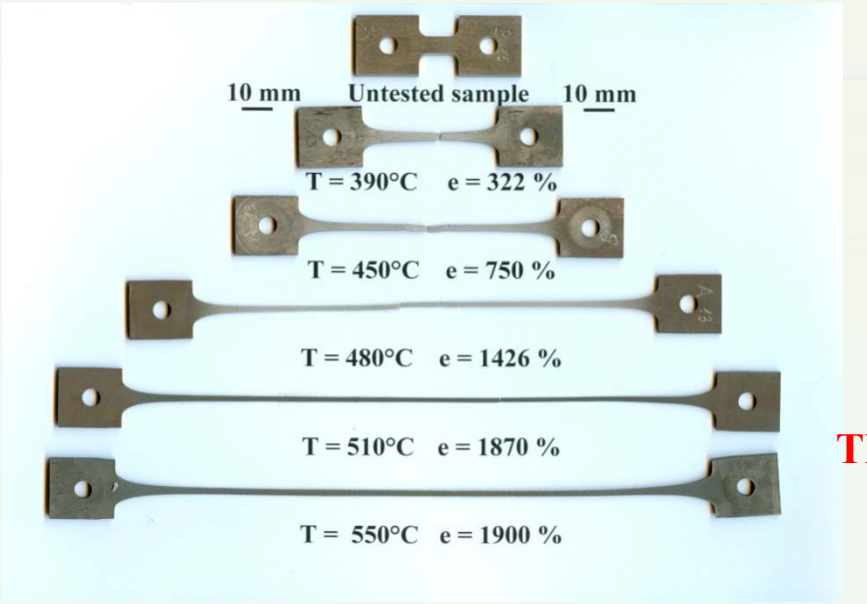
User interface

Aluminium alloys for superplastic forming





The equipment for the investigation of the superplastic properties.



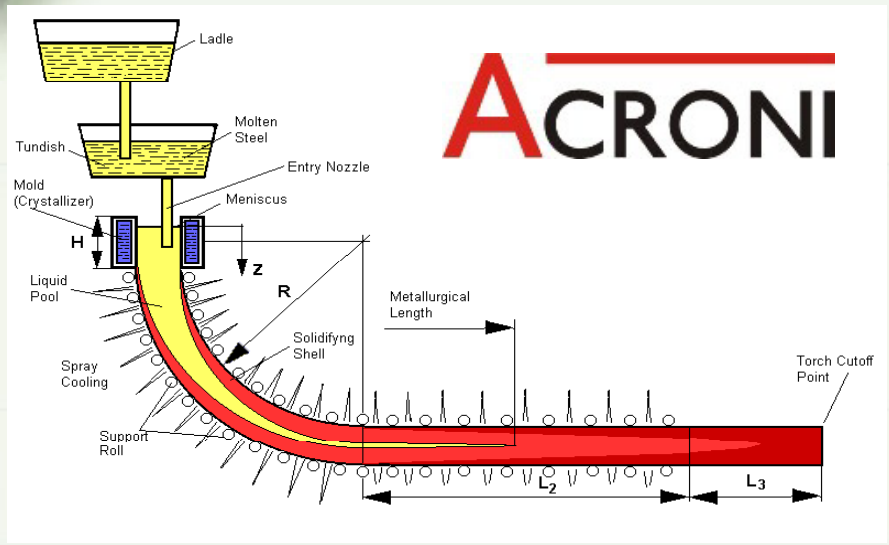
The highest elongation to failure was achieved at optimum forming conditions 2000 %.
The superplastic forming with suitable elongations over 400 % was also achieved at lower forming temperatures and higher strain rates. That is very important for the industrial production of superplastic sheets.

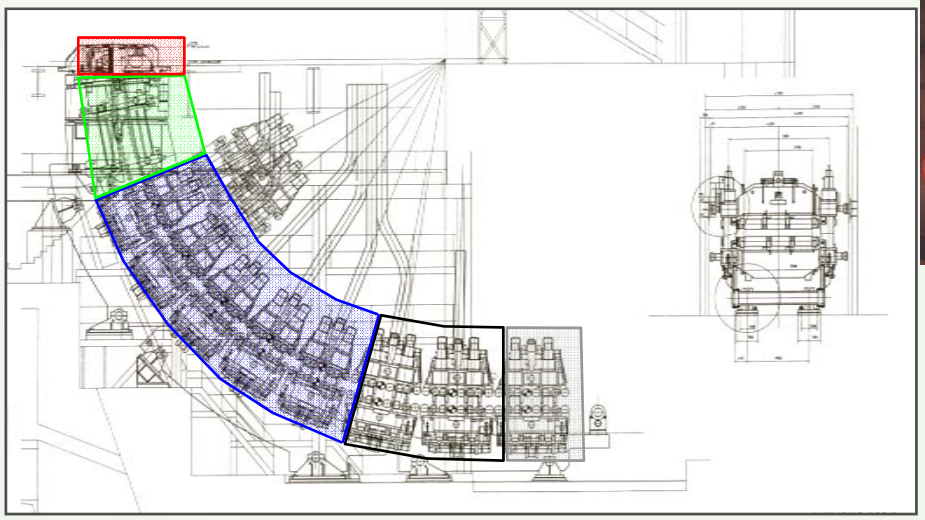
The samples of the Al-Mg-Mn-Sc alloy before and after the tensile tests at various temperatures and at constant initial strain rate.

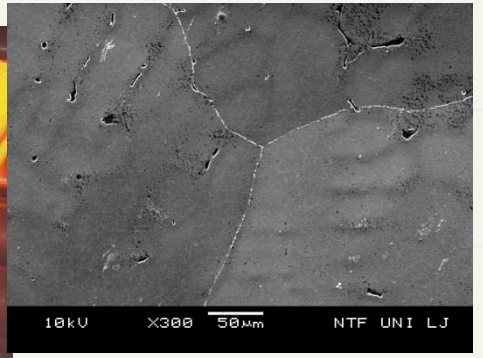
Modernization of the Continuous Casting Technology for Steel Semi-Products

FEBRUARY 2011

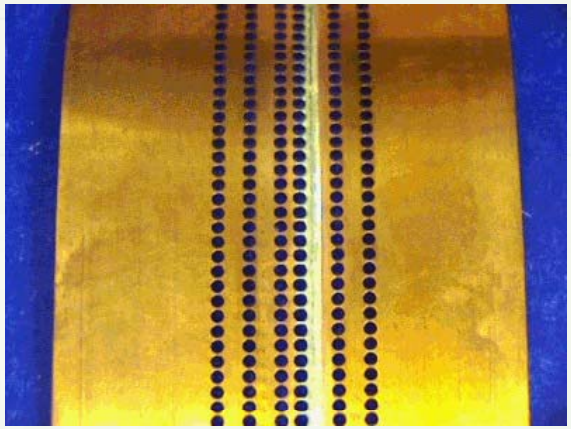
Anton Košir, MSc Thessys





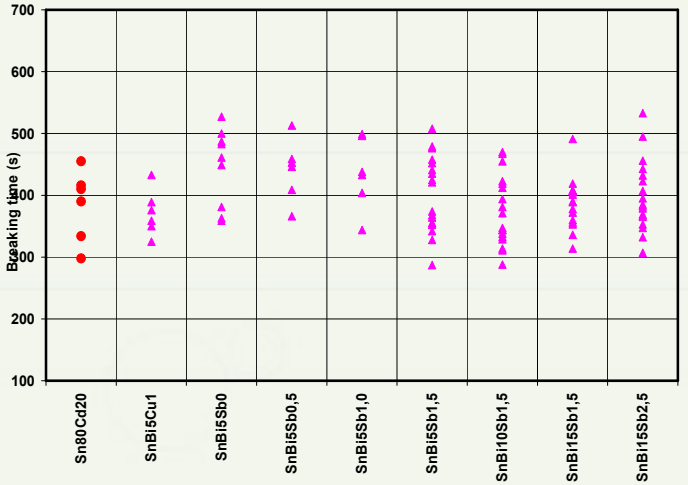


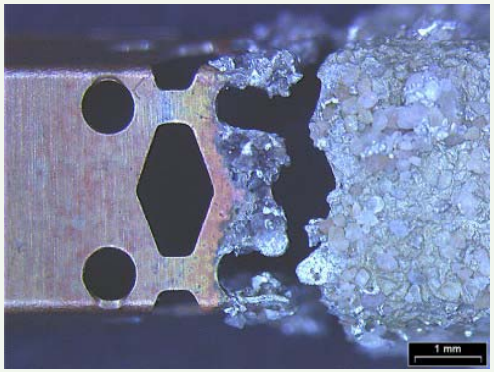
Fusible elements of low voltage fuses



Development of ecologically sound materials for fussible elements of low voltage fuses.

SnCd20 → **ETI-Sn-Bi-Sb**

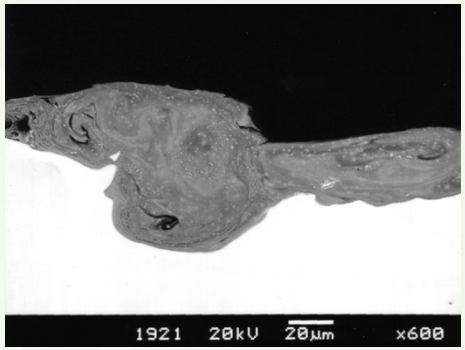


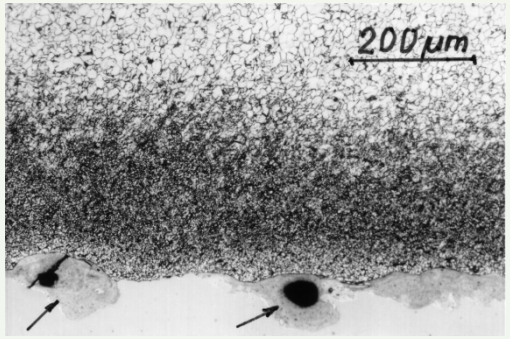


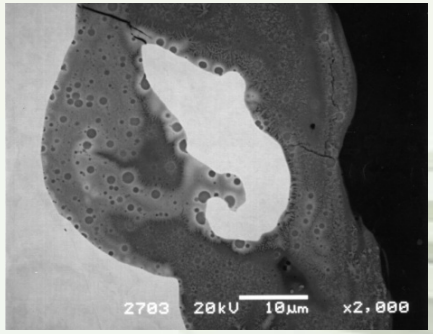
Synthesis of Composite Materials and Compounds with high Energy Rate

Metallic materials, whose properties are very different and whose dimensions are relatively large, can be efficiently welded together into a functional whole only through explosive welding. The explosive represents a source of large energy concentration, which is released in short time intervals and serves as an efficient tool for welding of materials whose mechanical, technological and physically chemical properties are very different and which, due to these factors and their large geometric dimensions cannot be welded together by any other currently recognized engineering procedure.

Within the framework of this program, we analyzed in detail welded plates of low-carbon steel – corrosion resistant austenite steel, low-carbon steel – tantalum, low-carbon steel – titanium, aluminum – titanium, aluminum – molybdenum, copper – tungsten and the triple layer: low-carbon steel – titanium - aluminum and low-carbon steel – titanium – zirconium, which were fabricated through explosive welding.



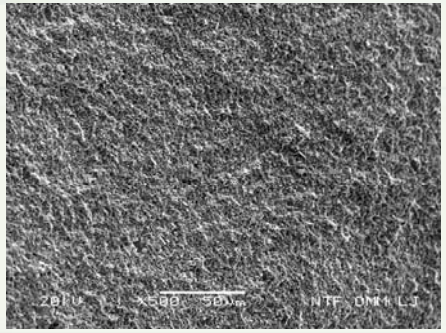


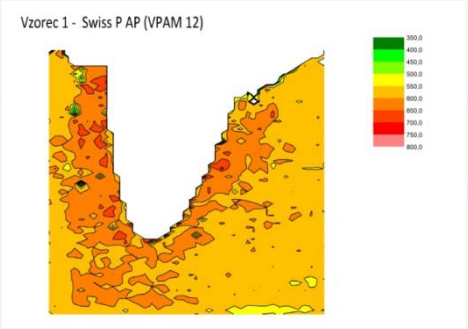


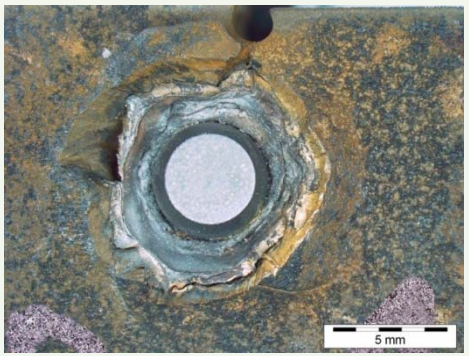
DEVELOPMENT OF NEW GENERATION OF ARMOUR PROTECTION STEEL

PROTAC

ACRONI d.o.o. – Protac d.o.o. - UL Faculty of Natural Sciences and Engineering -
- RCJ d.o.o. - VTI – Institute K. Kapetanovic - .....







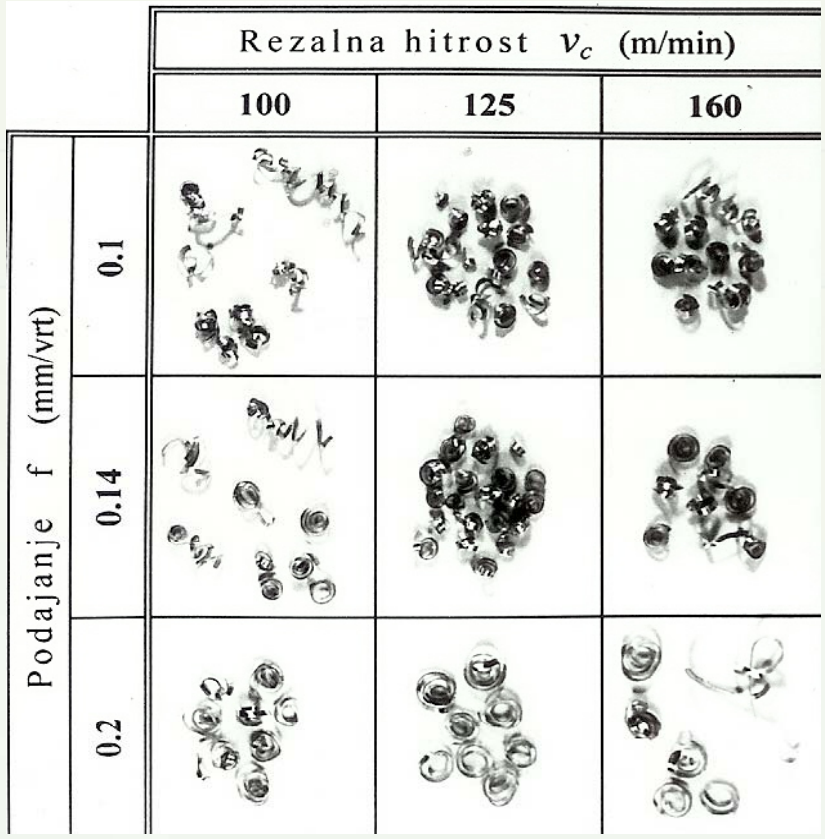
Ecological free-cutting aluminium alloys

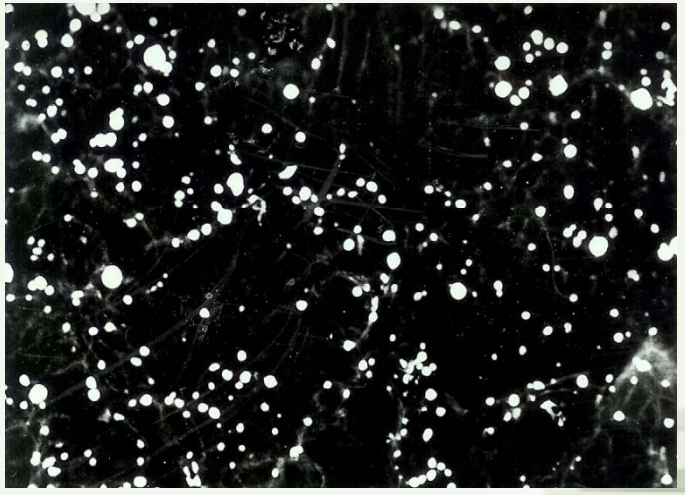
Al-Cu-Mg-Pb-Bi → Al-Cu-Mg-Sn-Bi

Al-Mg-Si-Pb-Bi → Al-Mg-Si-Sn-Bi

Al-Cu-Pb-Bi → Al-Cu-Sn-Bi

Gospodarska zbornica Slovenije
Chamber of Commerce and Industry of Slovenia

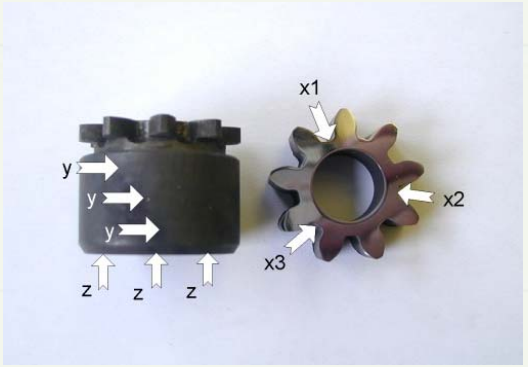


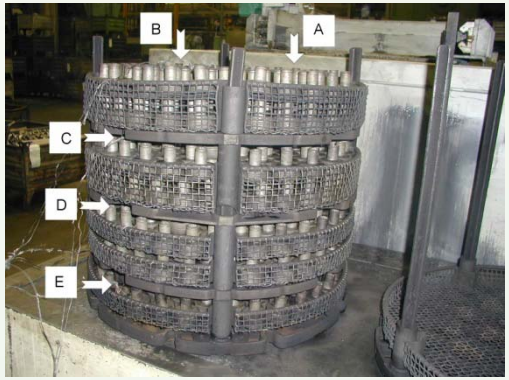


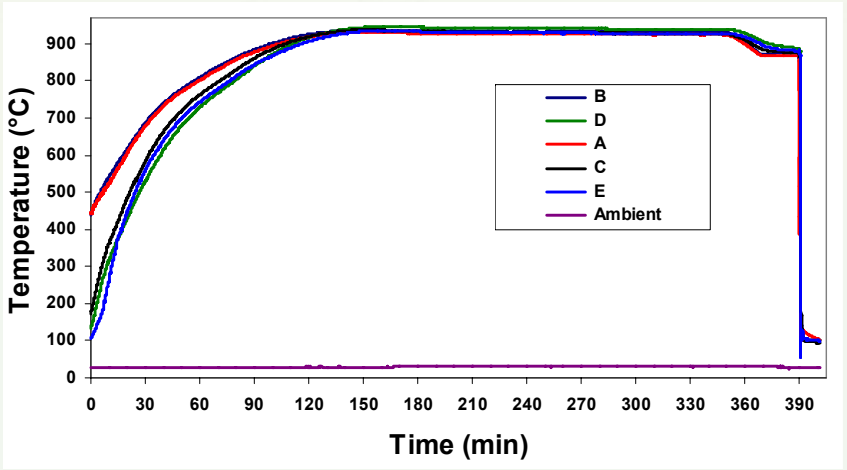
Microradiographic image of tin phases in Al-matrix

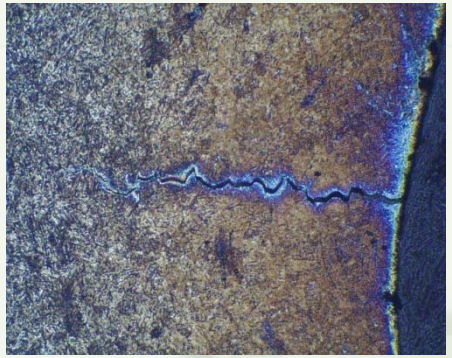
Optimisation of production technologies of steel semi-products for the automotive industry

ISKRA Avtoelektirka d.d. – UL Faculty of Natural Sciences and Engineering – UL Faculty of Mechanical Engineering







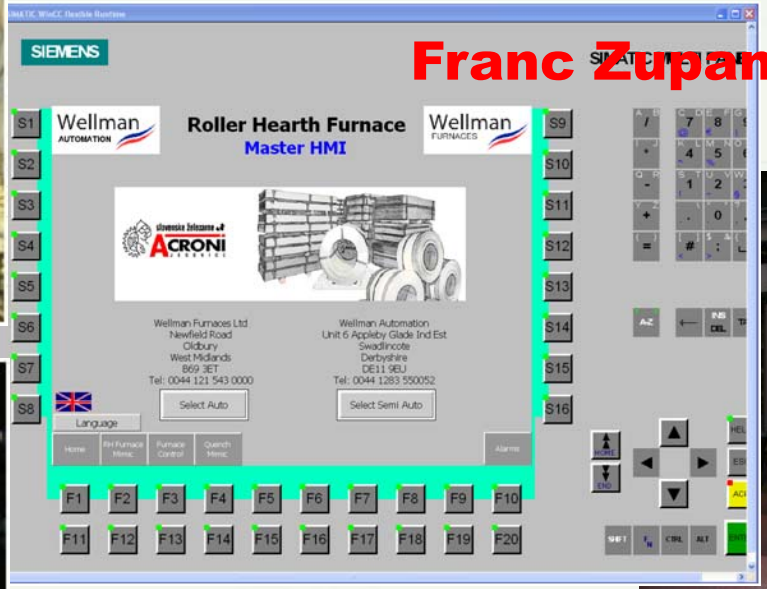


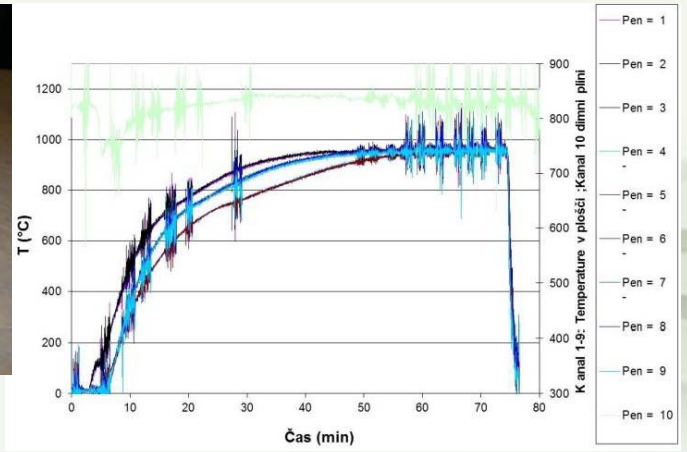
Iskra
Iskra Avtoelektrika d.d.

RECONSTRUCTION AND OPTIMIZATION LINE FOR HEAVY PLATES HEAT TREATMENT

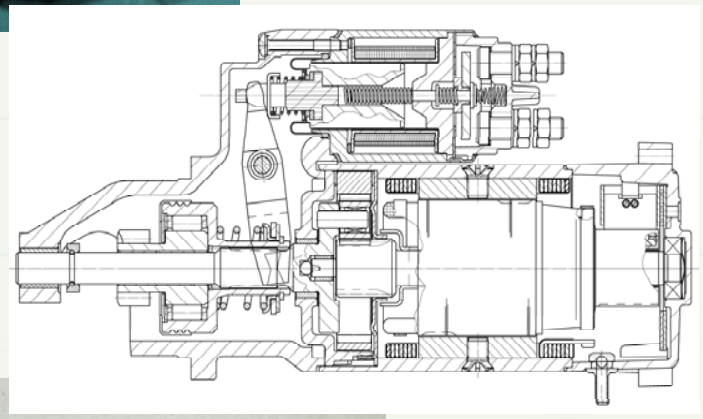
DECEMBER 2012

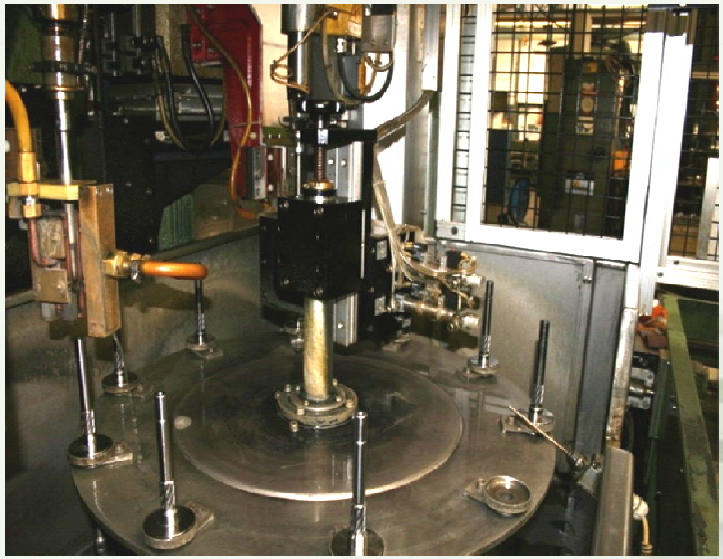
Franc Zupan, MSc Thessys





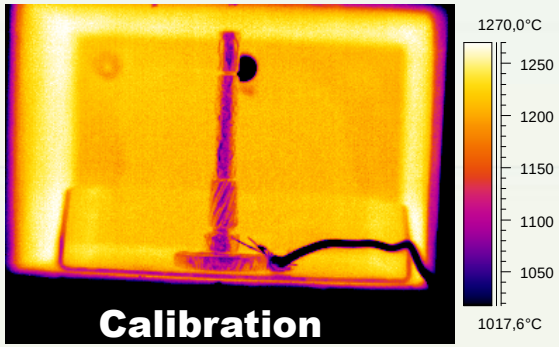
Inductive hardening of planetary shafts

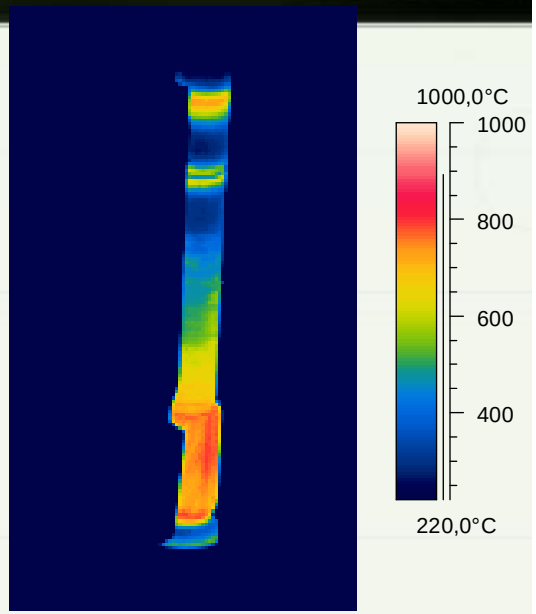


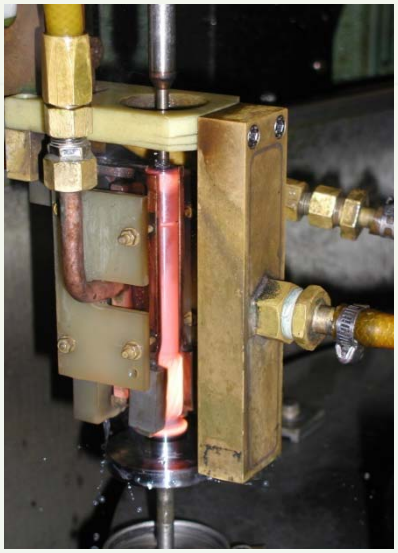


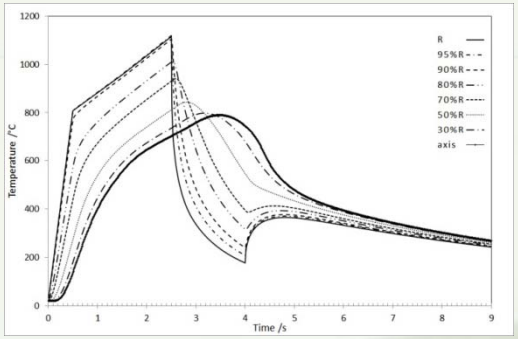
Inductive hardening of planetary shafts

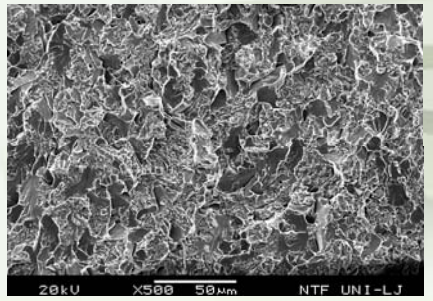
Thermographic camera
ThermaCAM PM675 FLIR
System





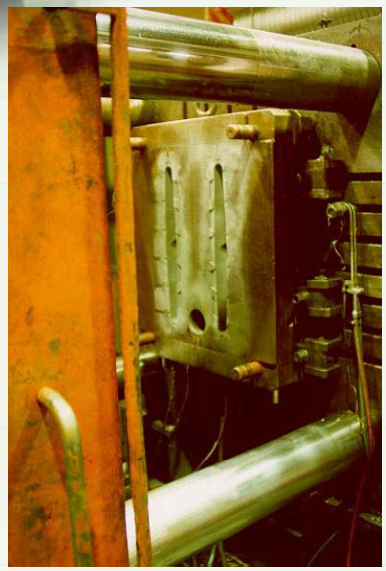


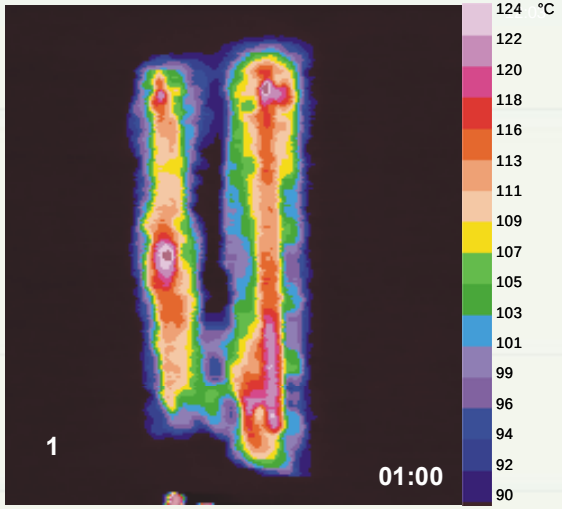


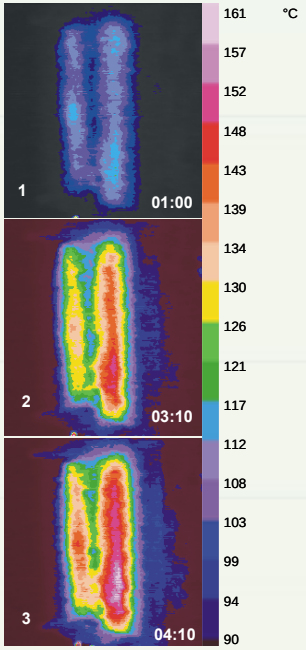


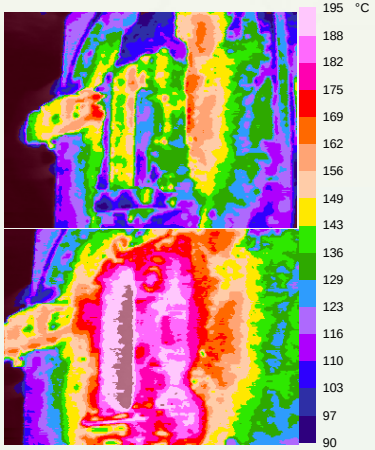
Failure Analysis of Dies for Aluminium Alloys Die-Casting

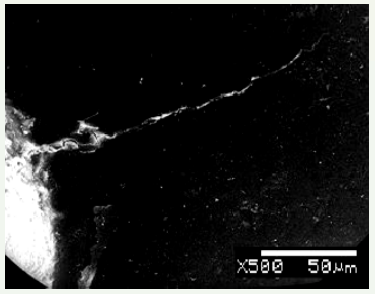
through thermographic measurements, and analysis by the non-destructive metallographic examination methods.





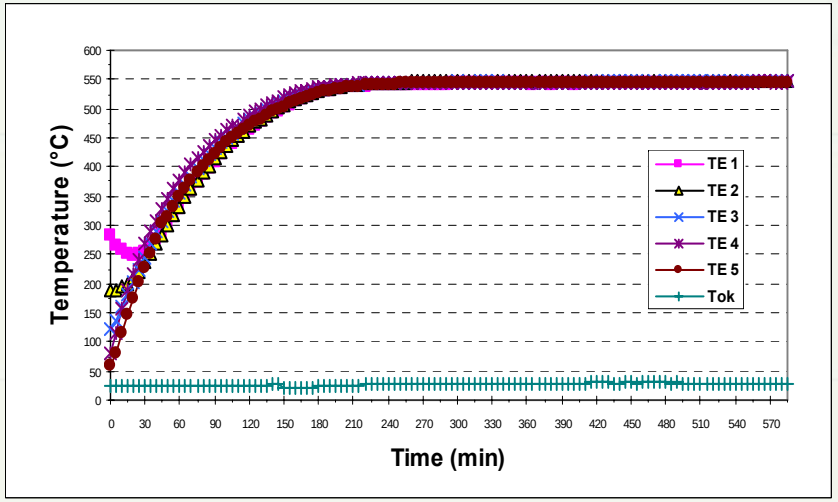


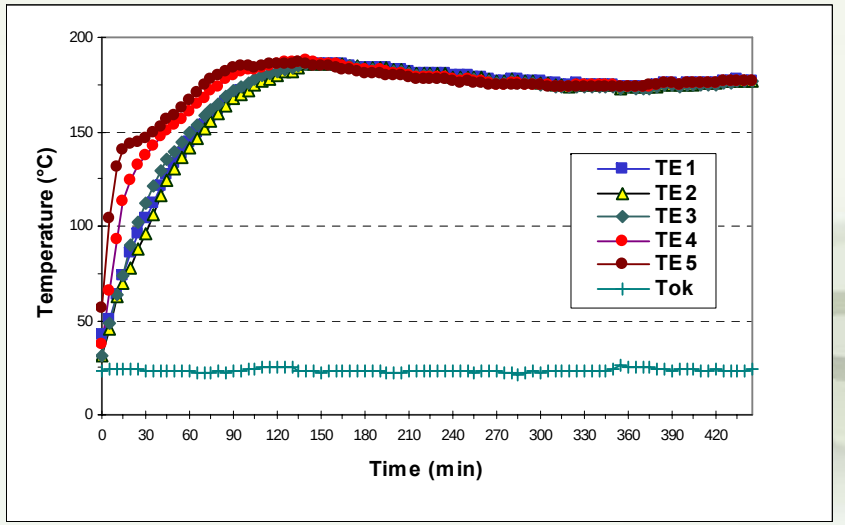




Temperature measurements of furnaces and charges during heat treatment processes

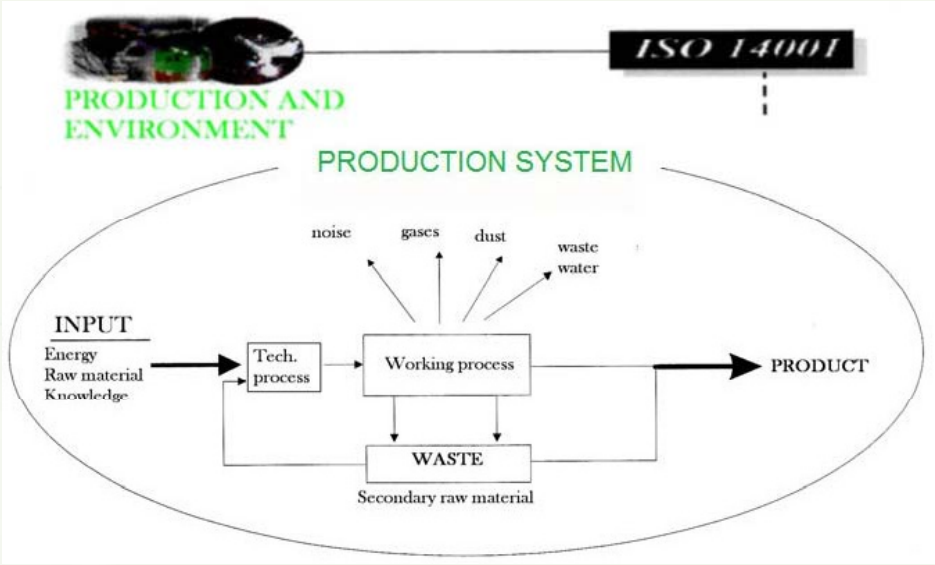
ACS

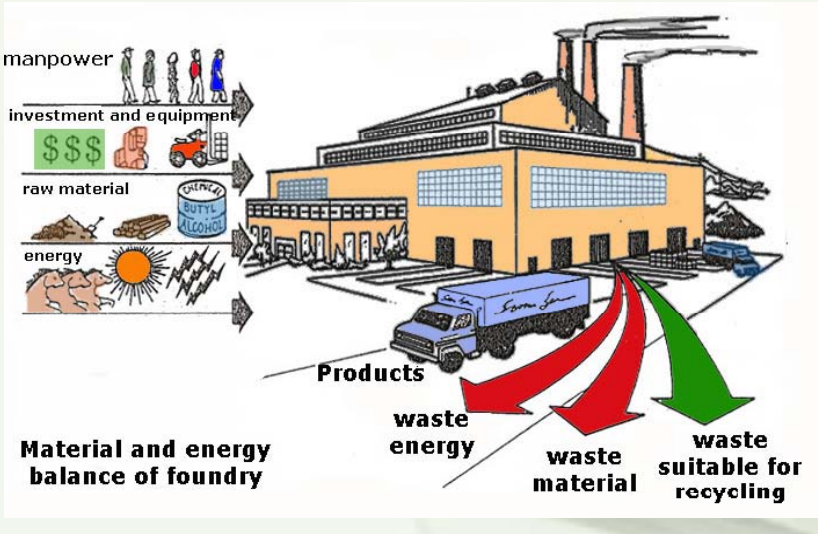




Industrial project
Foundry waste management

KOVA d.o.o.





dinos

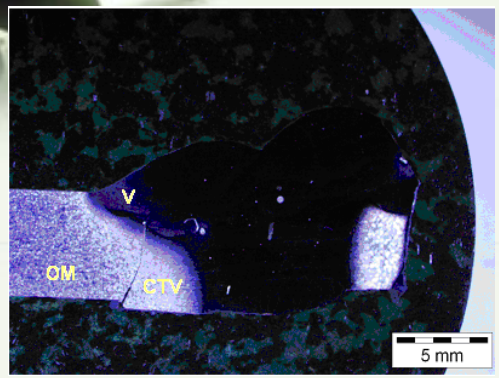
Failure Analysis

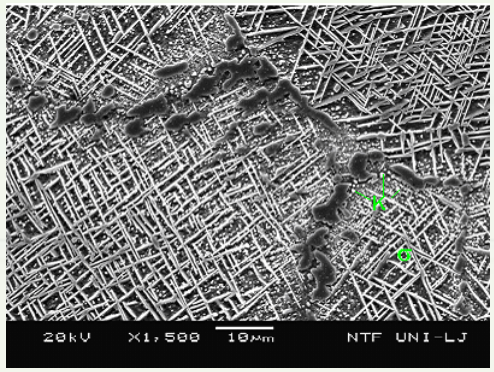
ANALYSIS OF DIE-CASTING DIE FAILURES

A DAMAGE OF THE SINGLE-SEAT CHAIRLIFT´S BASKET

FATIGUE CRACKING OF AN AIRCRAFT WHEEL

Failure Analysis

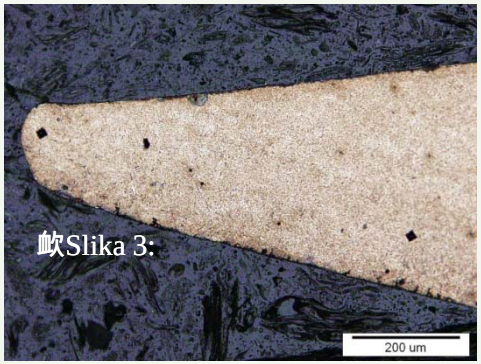


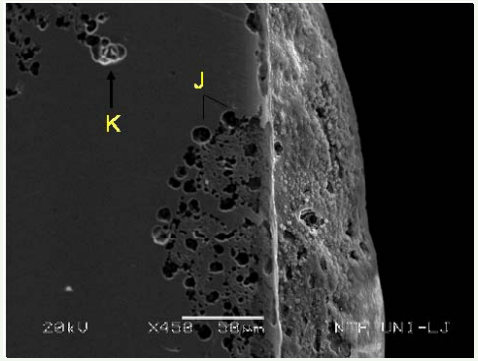


Cracks in heat exchanger (left) and microstructure in heat resistance steel after loading at high temperatures for a long time (right).

Fracture of a motor car spring as a consequence of fatigue corrosion due to cyclic loadings and a corrosion caused by a media in winter time conditions.

Fracture of a cement mill.





Wear of a cutting edge of a knife.
Knives for cutting wood have a blunt cutting edge because of insufficient mechanical properties that are a consequence of a unsuitable heat treatment.

Failure Analysis - Publication


Engineering Failure Analysis
Fatigue cracking of an aircraft wheel
B. Kosec, G. Kovačič, L. Kosec


Engineering Failure Analysis
Analysis of casting die failures
B. Kosec, L. Kosec, J. Kopač


Engineering Failure Analysis
Failure of steel pipes for hot air supply


Temperature Field Analysis on Active Working Surface of the Die-Casting Die

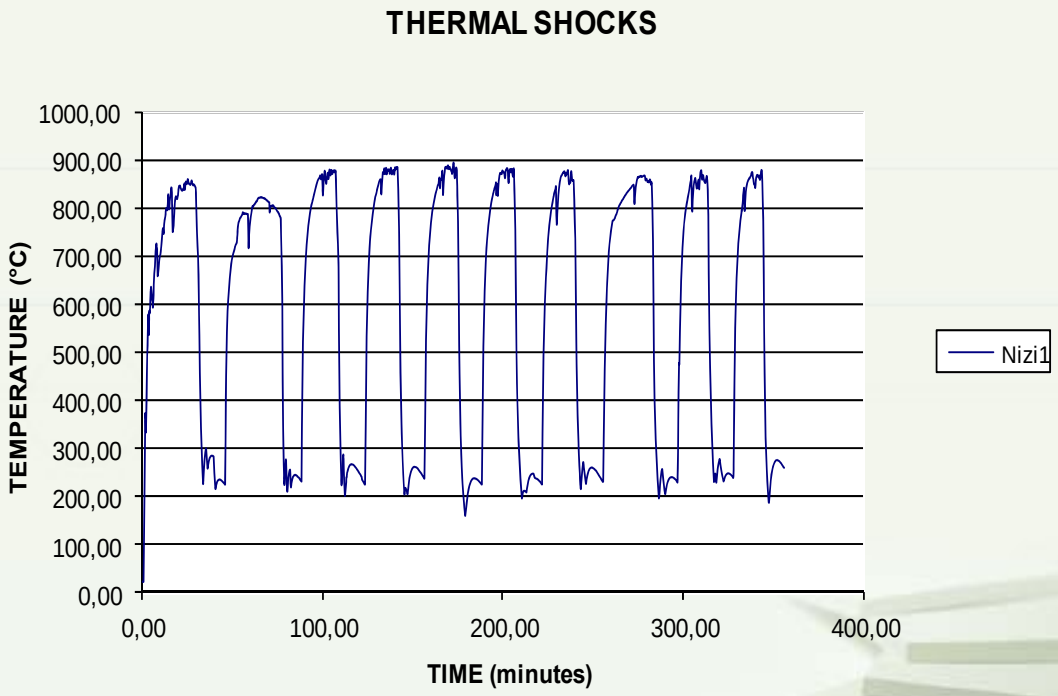

Engineering Failure Analysis
Analyses of defects on the surface of hot plates for an electric stove


Engineering Failure Analysis
Failure of the pinion from the drive of a cement mill


EFFICIENCY AND QUALITY OF INDUCTIVE HEATING AND QUENCHING OF PLANETARY SHAFTS

Idea I

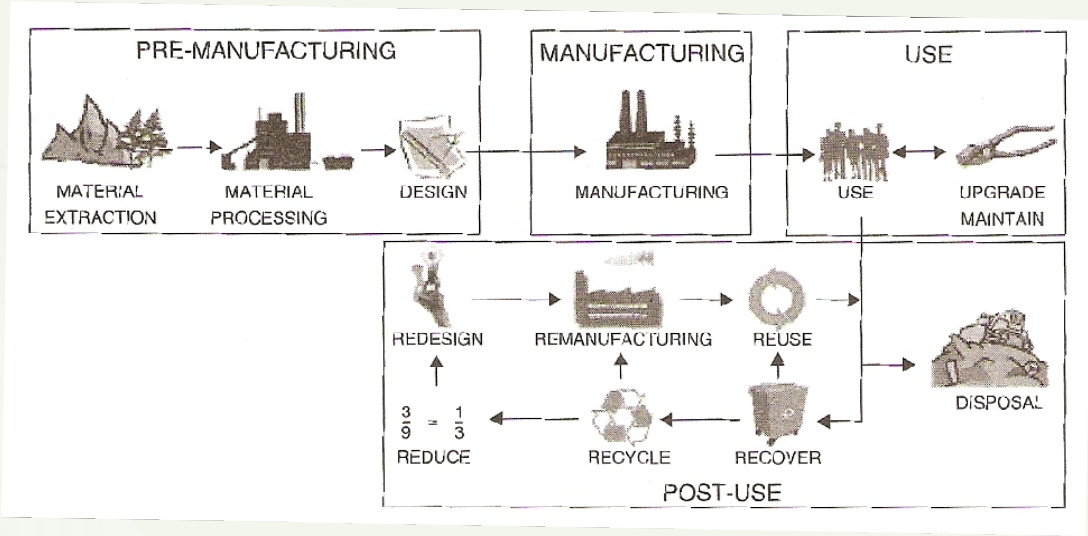
System for thermal shocks simulation



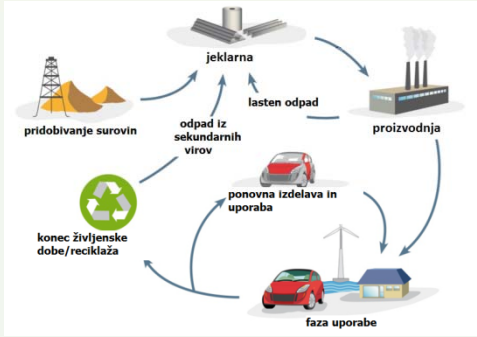
Idea II

Industrial project:
Product Life Cycle Analysis

The 6R Concept



3Rs (REDUCE, REUSE, and RECYCLE)
+
three other Rs (RECOVER, REDESIGN, and REMANUFACTURE)
=
6R concept



5. industrijski forum Inovacije, razvoj, tehnologije 2013

www.forum-irt.si

industrijski forum IRT
www.forum-irt.si

Portorož, 10. – 12. junij 2013

Dodatne informacije in prijava na dogodek:
Industrijski forum IRT, Motnica 7 A, 1236 Trzin
tel.: 01/5800 884 | faks: 01/5800 803 | e-pošta: info@forum-irt.si | www.forum-irt.si

EUROPEAN TOOLING FORUM
Portorož, Slovenia | 2013

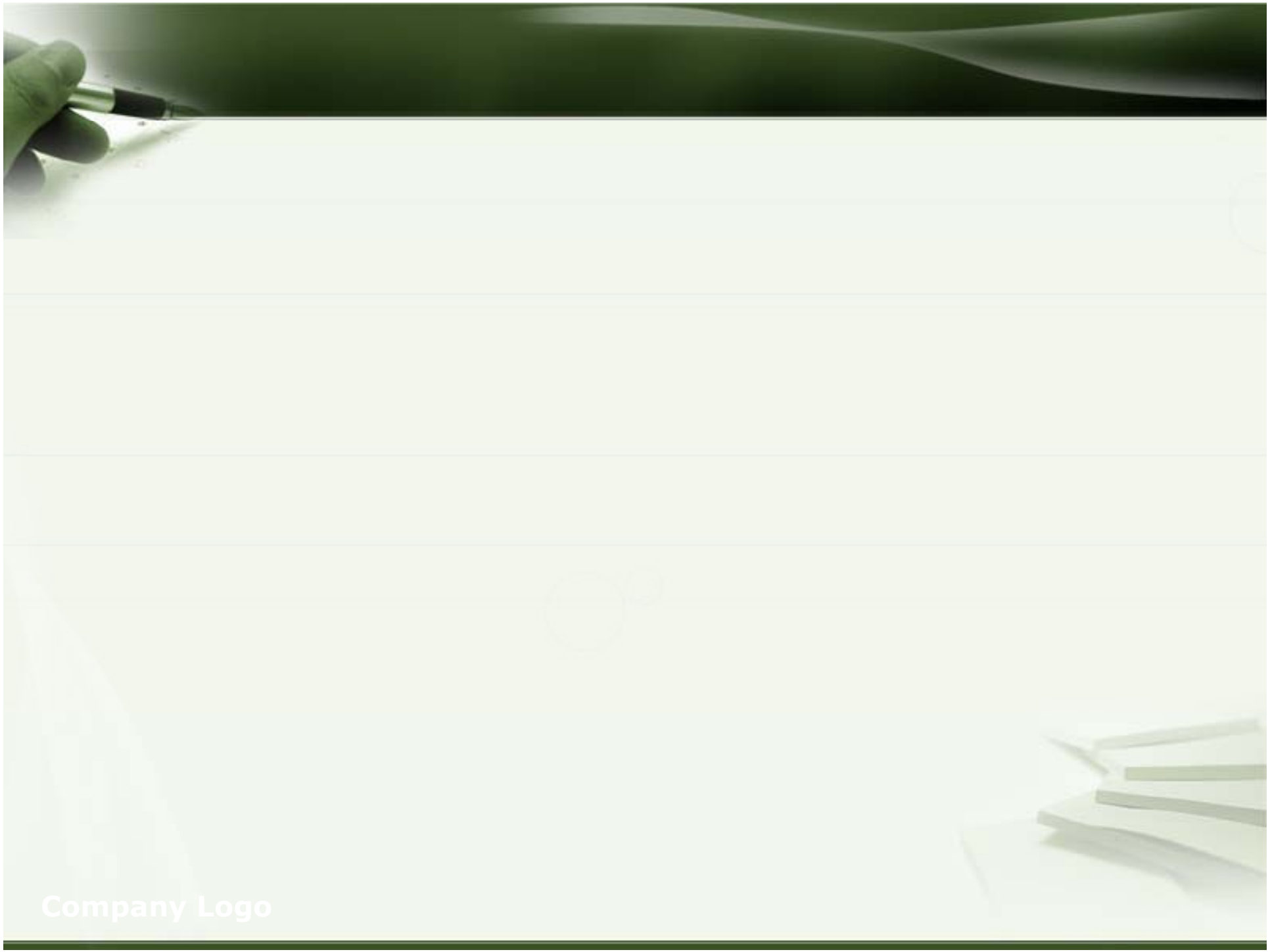
ISTMA europe

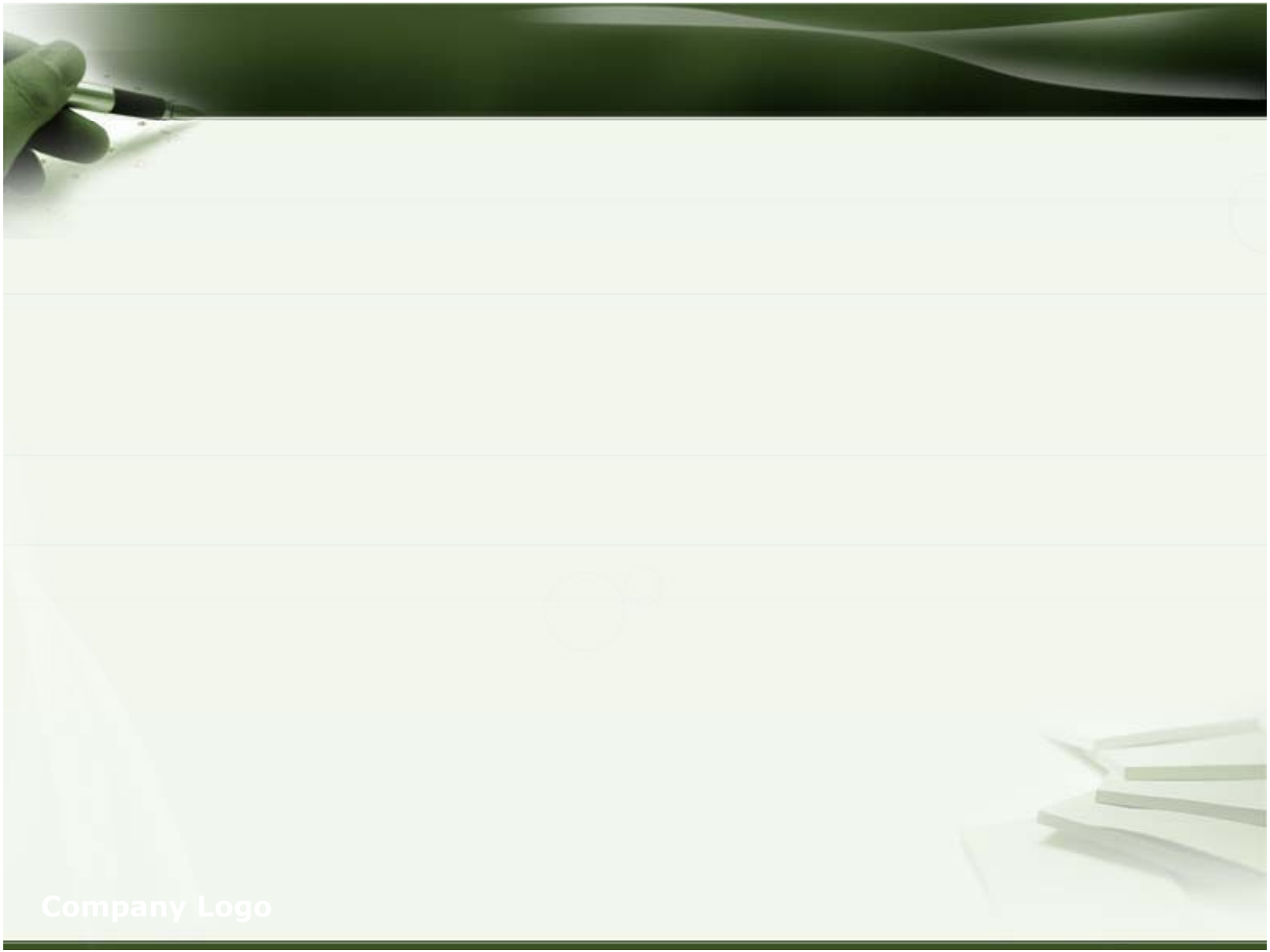
50. godina metalurškog instituta "Kemal Kapetanović" u Zenici

Sustav za spajanje motornih vozila

UNIVERZA
V LJUBLJANI

Thank you !


Company Logo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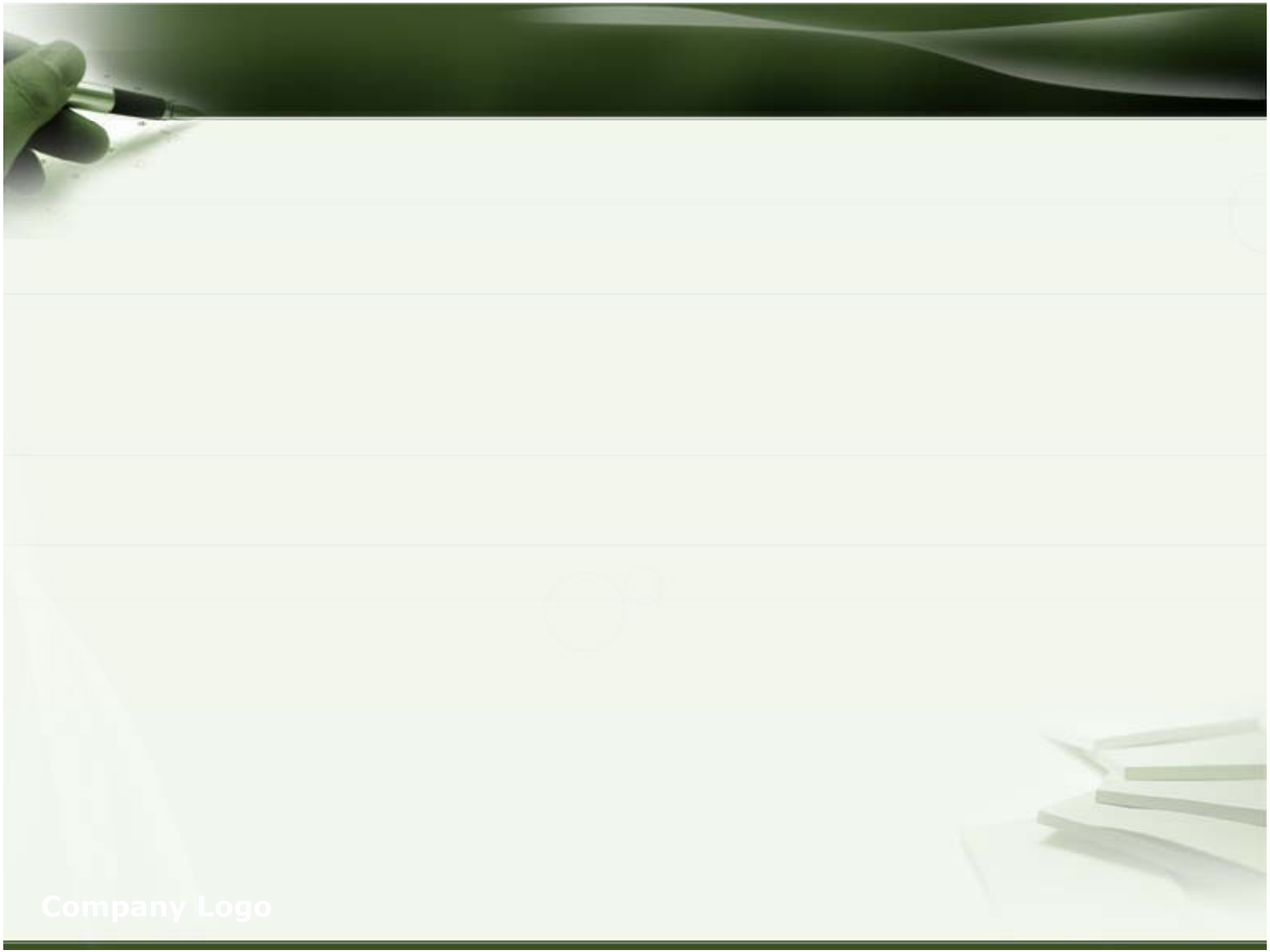
Company Logo

Julija leta 1919 so se dolgoletne želje po potrditvi slovenskega jezika oziroma narodnostne zavesti uresničile z ustanovitvijo Univerze v Ljubljani. Začel se je študij na petih fakultetah: pravni, filozofski, tehniški, teološki in medicinski.

Študij metalurgije se je začel leta 1935, ko je bil v sklopu rudarskega oddelka na tedanji tehniški fakulteti ustanovljen kabinet za fužinarstvo. V okviru tehniške fakultete se je leta 1939 pričel izvajati samostojni študij metalurgije v okviru odseka za metalurgijo.

V Fakulteti za naravoslovje in tehnologijo, ki je nastala leta 1960, je bil odsek za metalurgijo organizacijsko povezan v Oddelku za montanistiko skupaj z odsekoma za geologijo in rudarstvo.

Leta 1994 je po razdružitvi Fakultete za naravoslovje in tehnologijo nastala **Naravoslovnotehniška fakulteta**, ki jo sestavlja pet oddelkov: Oddelek za materiale in metalurgijo, Oddelek za geotehnologijo in rudarstvo, Oddelek za geologijo, Oddelek za tekstilstvo in Oddelek za kemijsko izobraževanje in informatiko.