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## Romania - Republic of Serbia IPA Cross-Border Cooperation Programme

# CLOSING CONFERENCE

Achievements of the ECOSOLDER Project.  
Recommended applications for ecological filler alloys.

21.11.2014.

Hotel Perla, Timisoara, Romania



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## Romania - Republic of Serbia IPA Cross-Border Cooperation Programme

# Retrospective of ECOSOLDER project - from beginning to final results - MMI Bor

Ana Kostov, Aleksandra Milosavljević, Radiša Todorović,  
Zoran Stevanović, Slađan Milenović, Vesna Florić

Mining and Metallurgy Institute Bor, Serbia



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Project:

ECOSOLDER

Implementation period:

15.06.2013. - 14.12.2014.

Duration of the project:

18 months

Total number of participants from MMI Bor:

6

Total budget of MMI Bor:

99.352,00 euro



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## Main objectives:

- Increasing the overall competitiveness of the economy in the border area.
- Finding specific technology solutions for getting solders that can be competitive in the cross-bordering, but also on the world market.
- Environmentally aspect, investigated solder alloys do not contain any toxic elements as opposed to the solders of wide use.



- Main aims:
- is to strengthen the scientific and technological cooperation between the Lead Partner and the Partner.
  - to contribute of promoting the development of SMEs, by focusing the possible investments upon the creation and development of local cross-border structures for business support
  - To achieve its goals, the project implement 16 activities at the operational level from which on 11 activities MMI Bor was involved.





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Within 17 months of realization of the project, from the side MMI Bor, it is realized all 11 activities and completely finished 10 activities.

The remain tasks are:

- After the Closing Conference, it will be published the last Press Release within activity no. 13 - Media Campaign.
- At the end of the project, the Progress Report and Consolidated Progress Report will be written and the final 6<sup>th</sup> reimbursement claim will be elaborated within activity no. 16.



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## Main realized activities and tasks in front the MMI Bor





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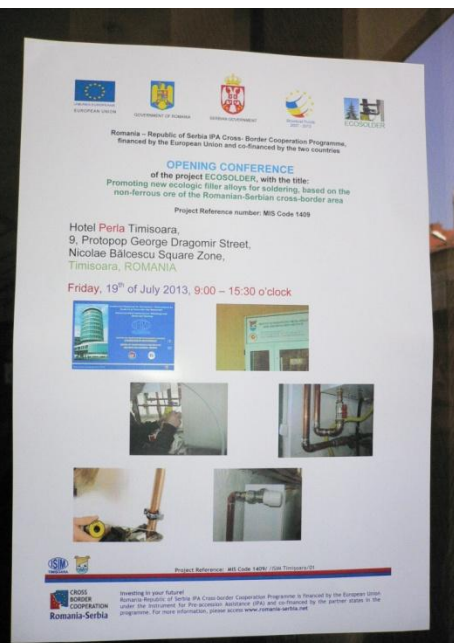
ECOSOLDER

# Opening Conference Timisoara, 19.07.2013.

Presentation of the Mining and  
Metallurgy Institute Bor,

Dr. Ana Kostov, Dr. Vlastimir Trujić,  
Dr. Zoran Stevanović

Eco -solder alloys for  
multifuncional application,  
Dr A.Kostov, Dr A.Milosavljevic,  
Eng R.Todorovic



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## Three Meetings





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Timisoara, 18.07.2013.



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Bor, 27.08.2013.



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## Three Workshops





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Timisoara, 21.02.2014.



LOW MELTING ECOLOGICAL SOLDER  
ALLOYS BASED ON TIN AND INDIUM

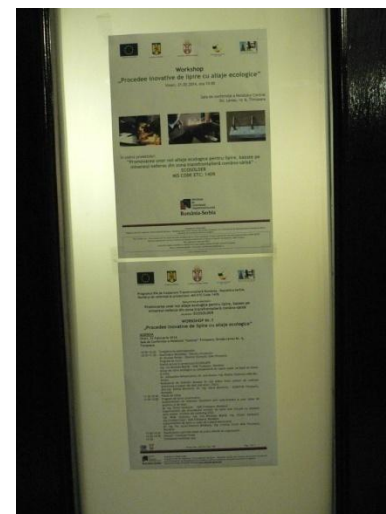
Dr A.Milosavljevic, Dr A.Kostov,  
Eng R.Todorovic



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Bor, 01.07.2014.



Promoting New Ecological Solders in  
Romanian-Serbian Cross-Border Area  
A.Kostov



PROPERTIES OF SOME LOW MELTING  
ECOLOGICAL SOLDER ALLOYS  
A.Milosavljevic, A.Kostov, R.Todorovic



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Bor, 01.07.2014.



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Timisoara, 26.09.2014.



SOME ASPECTS OF Sn-In-Cu  
ECOLOGICAL SOLDER ALLOYS  
A.Milosavljevic, A.Kostov, R.Todorovic



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- Realized and formed a data base for soldering filler alloys at ISIM Timisoara and MMI Bor.
- Creation of a direct IT connection, internet/web site of the project [www.ecosolder.eu](http://www.ecosolder.eu) and a R&D cooperation network between ISIM Timisoara and MMI Bor for soldering filler alloys.

- In front of MMI Bor:
- 21 documents are given for the date base.
  - 5 press release are announced
    - 2 interviews on 1 regional and 1 local television
    - 1 interview on regional newspaper



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Purchased of equipments for a laboratory and data basis for mechanical, thermal and environmental testings at MMI of Bor: 1 dilatometer and 2 devices for hardness measurements



Dilatometer, "Linseis" - Germany, model L76HS1400  
(15.000 euro)

Digital Portable Hardness Test, "Innovatest" - the Netherlands, model TH-160D, with integrated printer  
(1.850 euro)



Stable Hardness Test Rockwell "Innovatest" - the Netherlands, model 600A (2.450 euro)



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## Written a monograph from the side of MMI Bor



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ECOSOLDER

Dr Aleksandra Milosavljević

Dr Ana Kostov

## ECOLOGICAL LEAD-FREE SOLDERS Sn-In-X (X=Ag,Cu)

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in the programme. For more information, please access  
[www.romania-serbia.net](http://www.romania-serbia.net)

Project title: Promoting new ecologic filler alloys for soldering, based on  
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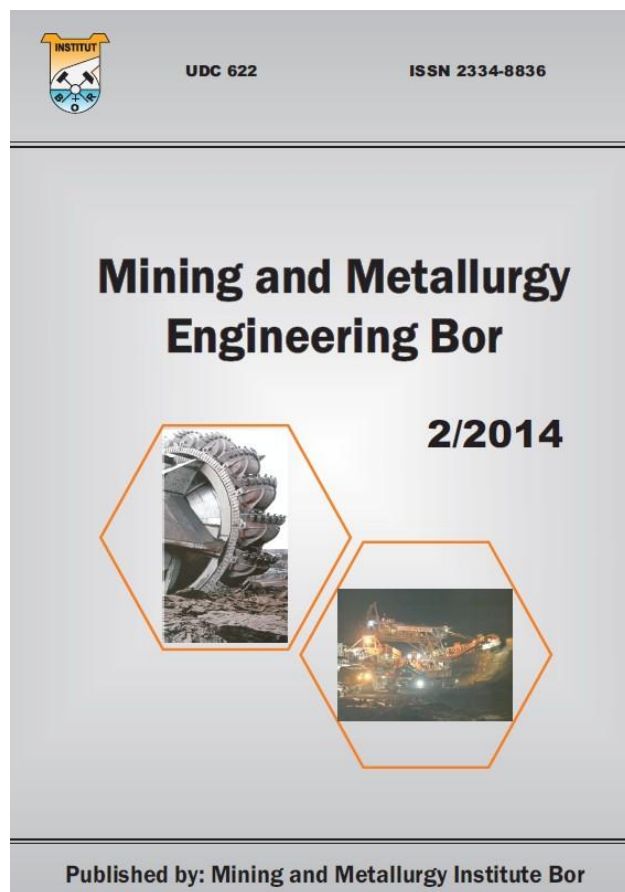
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## Publishing papers

## International journal



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UDK: 622

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UDK: 669.215/22:872/65(045)=20

DOI:10.5937/MMEB1402117K

Ana Kostov\*, Aleksandra Milosavljević, Radiša Todorović, Lidija Gomiđelović\*

### LEAD-FREE ALLOYS FOR ECOLOGICAL SOLDERS MANUFACTURING\*\*

#### Abstract

Although the European Union's directive about environment protection as WEEE and RoHS have been carried out in 2003, lead solders are still in use in Serbia. In the aim to respect the European and world directives and laws, it is necessary to reduce a quantity of toxic element and to establish lead and cadmium free solders in production. In this paper it was presented lead-free alloys, which are used for ecological solders manufacturing and various applications.

Keywords: ecological solders, lead-free alloys, silver, gold, tin, indium.

#### INTRODUCTION

On July 1, 2006 the European Union Waste Electrical and Electronic Equipment Directive (WEEE) and Restriction of Hazardous Substances Directive (RoHS) came into effect prohibiting the intentional addition of lead to most consumer electronics produced in the EU [1]. California is recently adopted a RoHS law [2] and China has a version as well. Manufacturers in the U.S. are received tax benefits by reducing the use of lead-based solder. With the European WEEE Directive now mandating a phase out of lead in electronic soldering and Japan's efforts to do the same even sooner, lead-free is rapidly taking on momentum around the world.

Namely, the available evidence indicates that measures on the collection, treatment, recycling and disposal of waste electrical and electronic equipment (WEEE) as set out in Directive 2002/96/EC of 27 January 2003 of the European Parliament and of the Council on waste electrical and electronic equipment [1] are necessary to reduce the waste management problem linked to the heavy metals concerned and the flame retardants concerned. In spite of those measures, however, significant parts of WEEE will continue to be found in the current disposal routes. Even if WEEE were collected separately and submitted to recycling processes, its content of mercury, cadmium, lead and

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\*\* The research presented in this paper has been done in the frame of the projects: "Development of ecological knowledge-based advanced materials and technologies for multifunctional application" No 34005 and "Modern multi-component metal systems and nanostructured materials with different functional properties" No 172037 financed by Ministry of Education, Science and Technological Development of the Republic of Serbia; as well as the project MIS ETC Code 1409, title "Promoting new ecological filler alloys for soldering, based on the non-ferrous ore of the Romanian-Serbian cross-border area" within the Romania - Republic of Serbia IPA Cross-Border Cooperation Programme.

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National journal

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ORIGINALNI NAUČNI RAD

Oblast: Materijali

EKOLOŠKI BEZOLOVNI LEM Ag-In-Sn

ECOLOGICAL LEAD-FREE SOLDER Ag-In-Sn

Aleksandra Milosavljević<sup>1</sup>, Ana Kostov<sup>1</sup>, Radiša Todorović<sup>1</sup>

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Izvod

Iako su direktive Evropske Unije o zaštiti životne sredine, kao WEEE i RoHS direktive, sprovedene još u 2003. godini, olovni lemovi se još uvek upotrebljavaju u Srbiji. U cilju poštovanja evropskih i svetskih direktiva i zakona, neophodno je da se smanji količina toksičnih elemenata i da se uspostavi proizvodnja leмова bez olova i kadmijuma. U ovom radu je predstavljena bezolovna legura koja se koristi za proizvodnju ekoloških leмова sa različitim aplikacijama.

**KLjučne reči:** ekološki bezolovni lem, srebro, indijum, kalaj

Abstract

Although the European Union's directive about environment protection as WEEE and RoHS have been carried out in 2003, lead solders are still in used in Serbia. In the aim to respect the European and world directives and laws, it is necessary to reduce a quantity of toxic element and to establish lead and cadmium free solders in production. In this paper it was presented lead-free alloy, which are used for ecological solders manufacturing and various applications.

**Keywords:** ecological lead-free solder, silver, indium, tin

1. UVOD

Svetska elektronska industrija koristi velike količine leмова na bazi olova. Međutim zbog svoje toksičnosti olovo predstavlja veliku pretnju životnoj sredini. Početkom dvadeset prvog veka, Kongres SAD-a je pokrenuo inicijativu da se olovo zameni drugim, manje štetnim metalima [1]. U Evropi i Japanu ova ideja je ne samo prihvaćena, nego i proširena. Prema WEEE direktivi, u Evropi iz upotrebe do 2010. godine treba izbaciti olovo, kadmijum, šestovalentni hrom i neke organske toksične supstance [1].

INSTITUT ZA RUDARSTVO I METALURGIJU BOR



—Cu—

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EKOLOŠKI BEZOLOVNI LEM Ag-In-Sn

15

#### 4. ZAKLJUČAK

Prikazani rezultat – novi lerni materijal na bazi indijuma, srebra i kalaja, tipa od značaja je u proširenju asortimana ekoloških bezolovnih leмова, koji mogu biti konkurentni ne samo na domaćem, već i na svetskom tržištu.

Kao najbitniji aspekt izdvaja se ekološki, obzirom da ispitivana lerna legura ne sadrži toksične elemente za razliku od leмова koji su kod nas u širokoj upotrebi. Navedena legura je u odnosu na olovne lemove svakako skuplja, ali se njena viša cena može opravdati potrebom za postizanjem odgovarajućih osobina, a i usklađu je sa novim zakonskim regulativama koje su na snagu stupile u Evropskoj Uniji 1. jula 2008. godine.

Sa stanovišta praktične primene, jedan od najbitnijih faktora je temperatura topljenja, jer određuje maksimalnu dozvoljenu temperaturu kojoj proizvod može biti izložen, a što utiče i na mikrostrukturu lernog spoja, debljinu intermetalnog sloja i broj prisutnih intermetalnih faza.

Takođe, važni faktor sa gledišta optimalnog hemijskog sastava prikazane lerne legure i njene ekonomske isplativosti, jeste i količina prisutnog indijuma u leguri, koja je dovoljno visoka kako bi obezbedilo sniženje tačke topljenja legure, ali i dovoljno niska kako ne bi došlo do pojave tzv. parcijalnog topljenja legure, što je nepoželjno u praksi.

#### ZAHVALNOST

*Autori se zahvaljuju na finansijskoj podršci IPA programu prekogranične saradnje Rumunija–Republika Srbija u okviru projekta: Promocija novih ekoloških leмова za lemljenje, na bazi obojenih metala iz ruda Rumunsko-Srpske prekogranične oblasti – ECOSOLDER, MIS ETC Code:1409.*

#### LITERATURA

- [1] Official Journal of the European Union, Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment, p.24.
- [2] Romania-Republic of Serbia IPA Cross-Border Cooperation Programme, Project title: Promoting new ecologic filler alloys for soldering, based on the non-ferrous ore of the Romanian-Serbian cross border area – ECOSOLDER, MIS ETC Code: 1409, 2013-2014.



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During the realization of the project, it was done the follows:

- Calculation and preparation of non-ferrous materials suitable for soldering.
- Preparing of equipment for melting and casting.
- Melting and casting of solders.
- Elaboration of some experimental results.
- Comparing experimental results with literature.
- Elaboration of studies regarding different types of soldering.
- Elaboration of studies regarding eco-materials for soldering.



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ECOSOLDER

During the realization of the project, it was done the follows:

It was investigated the various ecological solder alloys such as:

- Solder alloys based on tin (>50%) with addition of indium and silver
- Solder alloys based on tin (>50%) with addition of indium and copper
- Special brass solder alloys: Cu-Zn-Sn-Si-Mn

Also, different technologies are used to obtain these investigated alloys. The conditions of experiments were modified in order to obtain the most suitable eco-solder alloys.



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- Partner MMI Bor gave to the ISIM some small quantities of solder alloys, which are obtained at laboratory in MMI: solder alloy with indium (Sn-90%, In-7%, Ag-3%) and special brass in 3 different samples, in the aim to make some soldering and brazing experiments at laboratory in ISIM.
- The alloys taken into account are certainly more expensive compared to lead-containing solders, but their higher price is justified by the need to achieve particular properties.



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EUROPEAN UNION

26. septembar 2014.  
Zvezdara teatar/Zvezdara Theatre

**PROJEKTI NAJBOLJE PRAKSE 2012 – 2014**

**BEST PRACTICE PROJECTS 2012 - 2014**

**CROSS BORDER COOPERATION**  
**PROGRAMI PREKOGRANIČNE SARADNJE**

serbia / srbija



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26. septembar 2014. Zvezdara teatar/Zvezdara Theatre



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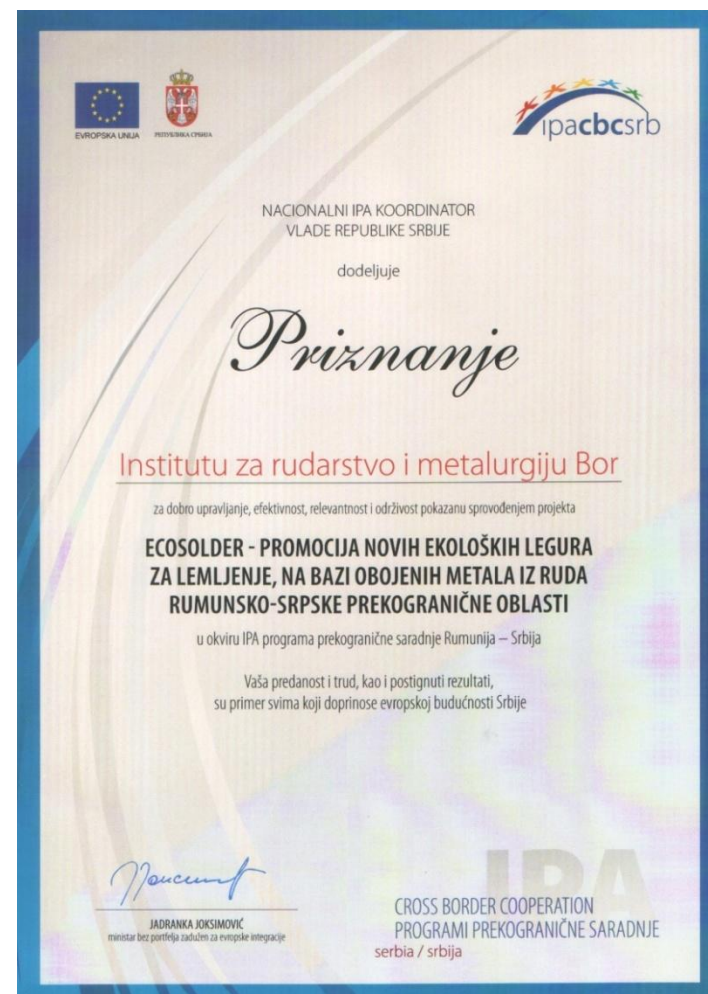
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## Awards of the Best Practice Project, Belgrade 26.09.2014





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**ECOSOLDER - Промоција нових еколошких легура  
за лемљење, на бази обојених метала из руда  
румунско-српске прекограничне области**

**ECOSOLDER - Promoting new ecological filler alloys,  
based on the non-ferrous ore of the Romanian-  
Serbian cross-border area**



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Институт за рударство и  
металургију Бор  
Национални истраживачко-  
развојни институт за заваривање  
и испитивање материјала ISIM  
Тимишвар



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National Research and Development  
Institute for Welding and Material  
Testing ISIM Timisoara





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Канцеларија за европске интеграције

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за лемљење, на бази обојених метала из руда  
румунско-српске прекограничне области**

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based on the non-ferrous ore of the Romanian-  
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Институт за рударство и  
металургију Бор  
Национални истраживачко-  
развојни институт за заваривање  
и испитивање материјала ISIM  
Тимишвар



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National Research and Development  
Institute for Welding and Material  
Testing ISIM Timisoara







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## Next steps

- The joint paper (MMI and ISIM)  
“Brazing procedure with a new ecological brass”  
by authors: Victor Verbičchi, Lia Boțilă; Cristian Ciucă,  
Ana Kostov, Aleksandra Milosavljević, Radiša Todorović  
will be published on the 3<sup>rd</sup> South-East European Welding Congress, June 03-05, 2015, Timisoara, Romania
- Cooperation with partners will be continued and reflected in the applications for new project cycles and programs such as:
  - IPA Cross-Border Cooperation Romania-Serbia Programme 2015-2020
  - Danube Transnational Cooperation Programme 2015-2020



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# Thank you very much for your attention!



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