

CROATIAN METALLURGICAL SOCIETY (CMS)
HRVATSKO METALURŠKO DRUŠTVO (HMD)

17th INTERNATIONAL / 17. MEĐUNARODNI

SYMPOSIUM OF CROATIAN METALLURGICAL SOCIETY
SIMPOZIJ HRVATSKOG METALURŠKOG DRUŠTVA

S H M D '2024

MATERIALS AND METALLURGY / MATERIJALI I METALURGIJA
BOOK OF ABSTRACTS / ZBORNİK SAŽETAKA

Obljetnice Hrvatskog metalurškog društva
Anniversaries of Croatian Metallurgical society

1952.-2024. HRVATSKO METALURŠKO DRUŠTVO / CROATIAN METALLURGICAL SOCIETY / 72 god./y

1962.-2024. ČASOPIS METALURGIJA / METALURGIJA JOURNAL / 62 god./y



ZAGREB, CROATIA, April 18 – 19, 2024
ZAGREB, HRVATSKA, 18. – 19. travanj 2024.

THE AIM OF SYMPOSIUM

The aim of this Symposium is to point out all the possibilities of the materials and achievements in metallurgy.

TOPICS OF THE SYMPOSIUM WERE:

Materials

- New Materials
- Refractory Materials
- The Development
- Applications
- Physical Metallurgy

Metallurgy

- Process Metallurgy and Foundry
- Plastic Processing of Metals and Alloys
- Technologies
- Energetics
- Ecology in Metallurgy
- Quality Assurance and Quality Management

17th International Symposium of Croatian Metallurgical Society „Materials and Metallurgy“ was held as a part of Anniversaries:

1952.–2024. HRVATSKO METALURŠKO DRUŠTVO / CROATIAN METALLURGICAL SOCIETY

1962.–2024. ČASOPIS METALURGIJA / METALURGIJA JOURNAL

„Countries Participating at the 17th International Symposium of Croatian Metallurgical Society“ – total 50 „Organizer“, „Co-organizer“, „Co-operation with organizations“, same as 16th symposium, Please see Metalurgija 62 (2023) 1, 8-10

ACCEPTED ABSTRACTS

Materials – Section „A“	45
Process Metallurgy – Section „B“	70
Plastic Processing – Section „C“	11
Metallurgy and Related Topics – Section „D“	43
Rejected Abstracts	55
TOTAL ABSTRACTS:	224

PATRONS (same as for 16th Symposium)

- World Steel Association (WSA)
- International Society of Steel Institutes (ISSI)
- European Steel Federation (ESF)
- European Steel Institute Confederation (ESIC)
- University of Slavonski Brod, Faculty of Mechanical Engineering, Croatia
- University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Croatia

NAPOMENA:

- Mnogi autori / koautori nisu se pridržavali zadanog oblika i dužine sažetaka referata. Znanstveni odbor je izveo usaglašavanje, te isprika ako postoje nedostaci. Moguće je i možebitni izostanak nekog sažetka. Sve Reklamacije se usvajaju do 30. ožujka 2024. god., posebice tisak, Metalurgija 63 (2024) 3.

NOTE:

- Many authors / co-authors have not observed the given form and length of abstracts of their reports. Scientific board has made adjustments, so we apologize if there are any faults. An abstract might be failing. All Protests will be accept till March 30, 2024, and after separately publish, Metalurgija 63 (2024) 3.

SCIENTIFIC COMMITTEE

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Dear Participants, Authors, Co-authors et al.,

Thirty years (1993-2023) have passed since foundation of International Symposiums of Croatian Metallurgical Society „Materials and Metallurgy“. First Symposium (September 15-17, 1993) was postponed due to war operations in Sisak, and subsequently held in Zagreb, February, 16-18, 1994. Till now total 16, Countries participating were about 50, over 70 differents Institutions, total 6 562 Abstracts of over 10 000 Authors and Co-authors.

Dear al., my thanks to You, because without You this Symposiums would have never come about.

Special thanks and compliments are to many Members of Committees Scientifics, Organizing, Honour Boards, Reviewers, Chairman of Sections etc.

I just hapen to be first amoving equals.

Leader of all Symposiums

Akad. I. Mamuzić, Prof.h.c.,dr.h.c.

Countries Participating at the 17th International Symposium of Croatian Metallurgical Society “Materials and Metallurgy”

1 Argentina	18 Greece	35 Portugal
2 Austria	19 Hungary	36 Romania
3 Belgium	20 India	37 Russia
4 Belarus	21 Indonesia	38 Saudi Arabia
5 Benelux	22 Iran	39 Serbia
6 Bosnia and Herzegovina	23 Italy	40 Singapore
7 Brazil	24 Japan	41 Slovakia
8 Bulgaria	25 Kazahstan	42 Slovenia
9 Chile	26 Korea	43 South Africa
10 China	27 Lithuania	44 Spain
11 Croatia	28 Macedonia	45 Sweden
12 Czech Republic	29 Malaysia	46 Thailand
13 England	30 Mexico	47 Turkey
14 Egypt	31 Montenegro	48 Ukraine
15 Finland	32 Netherlands	49 USA
16 France	33 Philippine	50 Vietnam
17 Germany	34 Poland	

All 17 Symposiums have been held:

- 1st Zagreb: 1994, February, 16-18 (88 lectures)
- 2nd Split: 1996, June, 20-22 (150 lectures)
- 3rd Šibenik: 1998, June, 25-27 (192 lectures)
- 4th Opatija: 2000, June, 25-29 (333 lectures)
- 5th Šibenik: 2002, June, 23-27 (375 lectures)
- 6th Šibenik: 2004, June, 20-24 (368 lectures)
- 7th Šibenik: 2006, June, 18-22 (475 lectures)
- 8th Šibenik: 2008, June, 22-26 (615 lectures)
- 9th Šibenik: 2010, June, 20-24 (541 lectures)
- 10th Šibenik: 2012, June, 17-21 (641 lectures)
- 11th Šibenik: 2014, June, 22-26 (689 lectures)
- 12th Šibenik: 2016, June, 19-23 (546 lectures)
- 13th Šibenik: 2018, June, 24-29 (561 lectures)
- 14th Šibenik: 2020, June, 21-26 (435 lectures)
- 15th Zagreb: 2022, March, 22-23 (527 lectures)
- 16th Zagreb: 2023, April, 21-22 (362 lectures)
- 17th Zagreb: 2024, April, 18-19 (224 lectures)

25. S. Zhuravlova, A. Marko, M. Boiko, O. Tanchev, V. Mameshyn

The use of agricultural waste in steel production. The growing proportion of advanced high-strength steels in overall steel production, typically containing higher carbon levels than conventional low-carbon steels, demands the application of carburizers. The utilization of sunflower husks, sunflower stalks, corn, and straw displays potential. However, the effective utilization of these biomaterials requires specific preparation technologies for carburizing steel. The paper examines the characteristics of carburizing materials obtained from bio-based resources and their influence on the steel carburizing technique, the chemical composition of steel and its uniformity.

26. M. Boiko, V. Treshchov, S. Zhuravlova, N. Poliakova

Use of plant-based carbon materials for metallization of iron ore pellets. Efficiently utilizing even small quantities of plant-based feedstocks from recycled materials in metallurgy allows us to save traditional fossil fuels and gain valuable experience using alternative fuel technologies in metallurgical production. We are considering the issue of replacing fossil fuels in the metallurgy of iron ore raw materials, thereby solving a whole group of problems: reducing the use of fossil fuels, simplifying steelmaking technology and the possible economic benefits of replacing natural gas with biomaterials. Biomaterials act as not just fuels, but also reducing agents in these operations.

27. V. Yefymenko, M. Boiko, M. Fursov, M. Yaholnyk

Green transitions in energy and metallurgy: exploring bio-based alternatives. Pyrolysis technology, drawing from diverse raw materials like garden and food waste, produces biochar is a sustainable alternative to coal, boasting porosity and stability. Similarly, vegetable oils such as soybean, palm and rapeseed present robust alternatives to fossil fuels. Krakow's Technical University in Poland has innovated a unique blend: 70-80% coal sludge with 20-30% plant waste, yielding solid fuel granules. Elsewhere, Poltava Mining, under Ferrexpo, utilizes sunflower husks as fuel, conserving 5 million cubic meters monthly. Integrating biomaterials in metallurgy can reduce flux costs. Direct iron production further sidesteps the polluting blast furnace stage, streamlining metallurgy.

28. V.V. Bochka, M.V. Yaholnyk, K.V. Shmat, A.V. Sova, M.O. Fursov

Evaluation of sinter stabilization efficiency during machining. The essential criteria for proficient stabilization of the sinter concerning particle size distribution and strength during machining are follows: the combined effect of impact, abrasion and splitting forces; lowering the loading energy during machining from 100 to 30-40 J/kg by reducing the size of the pieces themselves. By modelling various structural and technological factors that impact the destruction of lumps in a drum, the research was able to determine the nature and extent of their influence on the type and magnitude of load energy on the sinter.

29. I.Y. Vodin, I. Mamuzić

Theoretical substantiation and development of technology for the carbon-thermal process of ferrosilicoaluminum smelting. The work performed a thermodynamic analysis of the Al-O-C and Si-O-C systems using new and refined thermodynamic data. Phase equilibrium diagrams of the systems were constructed in the coordinates $\log(P_{\text{SiO}}/P_{\text{CO}}) - 1/T$, $\log(P_{\text{Al}_2\text{O}_3}/P_{\text{CO}}) - 1/T$. Based on thermodynamic analysis, the calculation of the material, thermal and energy balances of the carbon-thermal process of producing the Si45Al20Fe alloy (ferrosilicoaluminum) was carried out in relation to ore thermal smelting in the RKO-5.0 furnace. The data obtained were used in the development of technology for the carbon-thermal process of smelting ferrosilicon aluminum in relation to the conditions of existing ferroalloy plants in Ukraine (Zaporozhye and Nikopol ferroalloy plants).

30. V.F. Balakin, S.A. Sviridov, S.V. Savkin, Yu.M. Nykolayenko, T.V. Balakhanova

Modeling the influence of the texture of cold-rolled sheet on deformation behavior during high-speed deformation. The issues related to steel armor plates for Class 4-5 body armor with minimal weight are highly relevant. Traditional metallurgical and materials science approaches to producing homogeneous hot-rolled plates from armor steels have largely exhausted their capabilities. Multilayer plates made of cold-rolled carbon steel 08 KP with a thickness of 1 mm were used as samples for impact testing. The influence of the deformation texture orientation between the plates was simulated using ANSYS. Numerical modeling led to the conclusion of the necessity for further research.

31. S.A. Sviridov, S.V. Savkin, T.V. Balakhanova, I.A. Solovyova, V.F. Balakin

Enhancing the durability of armor plates using vibration. The application of physical methods in conjunction with the best examples of domestic steel armor will enable the production of lightweight, cost-effective Class 4-5 body armor. Low-frequency vibration, combined with various amplitudes, was employed as the dynamic impact on the armor plate. Tests were conducted on 30HN2MA and 30HGSA steels with a thickness of 6.7 mm. The results of bullet penetration tests (7.62 PS cartridge with a steel heat-treated core) demonstrated 100% protection when vibration was applied, whereas without vibration, the same plate experienced complete penetration.

32. T.A. Fonarova, I. Mamuzić

The concept of optimizing business processes within the framework of the compliance program of metallurgical production. This concept consists of the following phases: 1 – organization of business process improvement; 2 – documentation and development of a set of documentation techniques; 3 – analysis of opportunities for improvement; 4 – design of a new business process; 6 – implementation of solutions aimed at the future; 7 – management of administrative business processes for continuous improvement. It is advisable to design and manage all business processes within the framework of the metallurgical production compliance program, built on risk assessment and included in the enterprise information system using a decision support system.

33. T.A. Fonarova

Facilitation as a new direction in personnel management of metallurgical companies. Facilitation in the management of metallurgical enterprises ensures: 1) constructive collective interaction and cooperation in achieving the goal; 2) partnerships between the manager and employees create opportunities for solving problems and overcoming difficulties; 3) the effectiveness of training and advanced training of personnel at trainings, seminars, etc. The absence of a commanding and directive tone in relationships creates powerful motivational conditions for transforming intellectual potential into real human capital of an enterprise. Facilitation, as a modern personnel management tool, fully complies with the concept of value-based management and helps to increase the goodwill of a metallurgical enterprise.

34. I. Mamuzić, O. Dmitrieva, M. Lefterov, V. Huskova

Simulation of solid-particle interaction. To implement the simulation process, mathematical models of solid particle interaction were developed and justified, algorithms for processing elastic and inelastic collisions, motion, interaction were implemented, and relations for calculating numerical indices of forces were obtained. On the basis of motion and interaction models the known algorithms of numerical integration were modified. Taking into account the large volume of calculations, the application of parallel block methods for numerical solution of ordinary differential equations and their systems used to describe dynamic processes was proposed. The program system was developed using the principles of object-oriented programming and design patterns.

35. L.I. Solonenko, O.P. Bilyi, A.A. Taranov

Production of ceramic shell forms using man-made raw materials. The production of ceramic shell forms using man-made raw materials is an innovative approach to the creation of high-quality shell structures. It is necessary to select appropriate man-made raw materials, such as slag or dust. All materials are subject to appropriate processing and preparation. Casting of ready-made forms takes place according to the volumetric casting technology. This approach to the production of ceramic shell molds helps to conserve resources and helps to reduce the negative impact on the environment.

36. R.V. Usenko, O.V. Menailo, V.Yu. Shemet

Rational designs of high-strength cast iron molds with a cast gauge profile for rolling rolls. Rational designs of high-strength cast iron molds with a cast gauge profile for rolling rolls contribute to improving the efficiency of the production of metal products. The cast profile of the gauge ensures the exact geometry of the rolls and increases their service life, which is important for the quality of metal processing.

37. O.P. Bilyi, I.O. Osypenko, V.F. Mazorchuk

Designing technological departments of shops. The design of foundry departments involves optimizing the flow of materials and processes, which helps to reduce production time and reduce costs. In addition, it takes into account the introduction of advanced technologies and provides convenient