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KEMIJSKO-TEHNOLOŠKI FAKULTET

3. ZORH SUSRET

28. I 29. TRAVNJA 2022., SPLIT

Knjiga sažetaka



Fakulta materiálov,
metalurgie a recyklácie





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UNIVERSITY OF SPLIT
**FACULTY OF CHEMISTRY AND
TECHNOLOGY**

3RD ZORH CONFERENCE

SPLIT, APRIL, 28TH - 29TH, 2022

Book of Abstracts



**Fakulta materiálov,
metalurgie a recyklácie**



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PREDGOVOR

Susret znanstvenika, stručnih djelatnika i studenata na temu zaštite okoliša u Republici Hrvatskoj (3. ZORH susret) projekt je kojeg organiziraju studenti Kemijsko-tehnološkog fakulteta u Splitu zajedno s Fakultetom materijala, metalurgije i recikliranja u Košicama, SEA-EU Alijansom Europskog sveučilišta mora te studentskom sekcijom Hrvatskog društva kemijskih inženjera i tehnologa.

Prvi ZORH susret održan je 5. ožujka 2018. godine. Ovogodišnji 3. ZORH susret izlazi iz regionalnih okvira te postaje mjesto za susrete, razmjenu mišljenja i iskustva te uspostavu suradnje među sudionicima s visokih učilišta, instituta i gospodarstva iz raznih europskih zemalja. Uz širenje znanja i vidika te usvajanje novih ideja i tehnologija, susret je omogućio povezivanje velikog broja ljudi s različitih institucija kao i pokretanje novih projekata. Promatranjem zapadnih država, uviđamo sve veću potrebu za povezivanjem akademske zajednice s privredom, te želimo potaknuti studente da kritički i odgovorno pristupaju poslovima koji uvelike utječu na okoliš.

Kroz usmena i posterska izlaganja vrsnih stručnjaka i znanstvenika te studenata proširit će se informacije i doprinijeti razvoju svijesti o zaštiti okoliša. Ove godine najbolji radovi bit će objavljeni u časopisima Kemija u industriji, The Holistic Approach to Environment i Journal of Sustainable Technologies and Materials.

Hvala svima koji su doprinijeli organizaciji 3. ZORH susreta, a osobito Organizacijskom i Znanstveno-programskom odboru bez kojih ovaj susret ne bi bilo moguće realizirati. Cijenim svaku pruženu pomoć u nastojanju da se uspješno organizira ovako veliki projekt. Svim sudionicima i sponzorima želim zahvaliti što su se odazvali našem susretu i prepoznali njegovu važnost!

Predsjednica Organizacijskog odbora



Klara Magaš, univ. bacc. ing. cheming

PREFACE

The 3rd International Convention of Scientists, Specialist Employees and Students on the Topic of Environmental Protection in the Republic of Croatia (3rd ZORH convention) is a project organized by students of the Faculty of Chemical Technology of Split in cooperation with the Faculty of Materials, Metallurgy and Recycling in Košice, SEA-EU European University of the Seas and the student section of the Croatian Society of Chemical Engineers and Technologists.

The first ZORH meeting was held on March the 5th, 2018. This year's 3rd ZORH convention is expanding from the original regional framework and is aiming to become a place for gathering, exchanging viewpoints/experiences and for establishing cooperation between participants from higher education institutions, institutes and industry from various European countries. In addition to spreading knowledge and perspectives and adopting new ideas and technologies, the meeting enabled the connection of a large number of people from different institutions, as well as the launch of new projects. By observing the countries from the West we notice a growing need to connect the academic community with the industry and we want to encourage students to take a critical and responsible approach to jobs that greatly affect the environment.

The exchange of experience through oral and poster presentations by top experts, scientists and students is the best way to spread information and contribute to the development of environmental awareness. This year, the best papers will be published in the journals Chemistry in Industry, The Holistic Approach to Environment, and Journal of Sustainable Technologies and Materials.

I would like to thank everyone who contributed to the organization of the 3rd ZORH meeting, and especially to the Organizing and Scientific-Programme Committee, without which this convention would not have been possible. I appreciate all the help provided in the effort to successfully organize such a large project. I would like to thank all the participants and sponsors for responding to our meeting and recognizing its importance!

President of Organizing Board



Klara Magaš, univ. bacc. ing. cheming

3. Međunarodni susret znanstvenika, stručnih djelatnika i studenata na temu zaštite okoliša u Republici Hrvatskoj (3. ZORH Susret) 28.-29. travnja 2022.

RECIKLIRANJE TISKANIH PLOČA HIDROMETALURŠKIM PROCEDURAMA: PRINCIP I METODOLOGIJA

APPROACH ON RECYCLING OF PRINTED CIRCUIT BOARDS (PCB) VIA HYDROMETALLURGICAL PROCEDURES: PRINCIPLE AND METHODOLOGY

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Recent mankind demand for electronic devices is in constant upgrowth, those devices always contain printed circuit boards (PCB) which are mainly constructed of plastics, semi-conductors and decent content of various metals. Hence, in the end-of-life of those products, it is highly recommended to recover those materials or functionalize those waste into other products or feed materials, in order to lessen their harmful impact on the environment. One of the promising processing procedures is hydrometallurgical treatment, since it is cost-effective and simple. In order to recover metals as aqueous soluble salts, crushed and milled PCB is air-pyrolyzed and obtained powder is processed as start material in leaching experiments. The use of concentrated aqua regia led to the passivation of solid material and consequently impede the leaching process. Dry-digestion leaching using concentrated sulfuric acid partially leached some metals. The highest leaching rate ($\geq 70\%$) has been achieved using diluted sulfuric acid (for Al, Ni, Fe, Co, and rare-earth) and copper yield was highest utilizing $2\text{ M H}_2\text{SO}_4 + 3\text{ M H}_2\text{O}_2$; $S/L = 0.1\text{ g/ml}$. While sulfuric acid has accomplished some results for enumerated leachates, it achieved limited success for leaching Ba, Pb, Ag, Au, Pt and Pd. Overall findings imply that hydrometallurgical procedures may be used but only together with previous separation techniques. That approach would increase overall leaching with oxidizing agents and enable leaching of noble metals.

Key words: PCB, recycling, acid leaching, metals recovering

3rd International convention of scientists, specialist employees and students on the topic of Environmental protection in the Republic of Croatia (3rd ZORH convention) on 28th-29th of April 2022

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