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# WVZ INTERNATIONAL CONGRESS

# VII

**ENGINEERING, ENVIRONMENT AND MATERIALS  
IN PROCESS INDUSTRY  
EEM2023**

## **BOOK OF ABSTRACTS**



**JAHORINA  
MARCH 20-23, 2023**

**REPUBLIC OF SRPSKA  
BOSNIA AND HERZEGOVINA**

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**BOOK OF ABSTRACTS**

# **VIII INTERNATIONAL CONGRESS**

***ENGINEERING, ENVIRONMENT AND MATERIALS IN  
PROCESS INDUSTRY***

***EEM2023***

**UNDER THE AUSPICES OF  
MINISTRY OF ECONOMY AND ENTREPRENEURSHIP OF THE REPUBLIC OF  
SRPSKA**

**AND**

**ACADEMY OF SCIENCES AND ARTS OF THE REPUBLIC OF SRPSKA**

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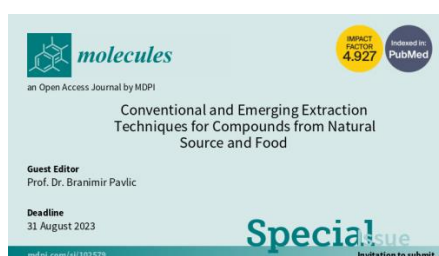
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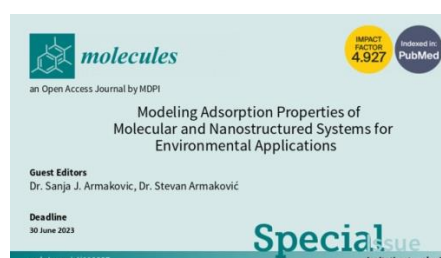
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# GENERAL SPONSORS

## CITY OF ZVORNIK

The municipality of Zvornik covers the surface area of 387 square kilometers in the north-eastern part of the Republic of Srpska in Bosnia and Herzegovina, an area with the population of 65 000. The town of Zvornik is situated on the eastern slopes of the mountain of Majevisa, at 146 m above sea level. It is surrounded by the municipalities of Bratunac, Milići, Vlasenica (to the south), Šekovići, Osmaci, Sapna, Kalesija (to the west), Lopare, Ugljevik and Bijeljina (to the north). The river Drina on the east is a borderline with Republic of Serbia, i.e. the town of Loznica and the municipality of Zvornik.

The municipality of Zvornik is a crossroads of important roads to Sarajevo, Belgrade, Novi Sad, Bijeljina and Tuzla. Two bridges

on the river Drina for road and rail traffic connect this area with the wider region, with Zvornik in the center, at equal distances from the three major cities – Belgrade, Novi Sad, and Sarajevo (approximately 160 km).

Fertile plains, a river rich in fish and suitable for navigation, mountains rich with forests, game and minerals have attracted people to settle the area since prehistoric times, and the earliest known inhabitants were the Scordisci, a Celtic tribe. The name Zvornik has been used since 1519, and the settlement was first mentioned in 1410 under the name of “Zvonik“. Historic sites include the old town Đurđevgrad or the Zvornik fortress, the old town of Kušlat, The Andraš villa, the sheik's türbe, and the türbe of the poet Kaimija, necropolises and medieval tombstones called “stećci“, the church St John the Baptist, and the local museum holds a collection of specimens of the cultural and historic heritage.

Natural resources include the hydro power potential of the river Drina as it runs through its territory for 50 km. Zvornik lake covers the surface area of 19 square kilometers (25 km in length and 1.3 km in width). It offers great possibilities for tourism, sports and recreation. The resources include the springs of mineral water from Kozluk and Vitinički Kiseljak, reserves of quartz sand, brick clay, structural stone, limestone and gravel. The municipality has 13 700 ha covered by forest, 16 600 ha of arable land, and 10 500 farming households.

The municipality of Zvornik has 280 companies with 4500 employees, 800 businesses with 13000 employees, and around 40 institutions with approximately 2500 employees.

The most significant companies are AD Alumina factory Birač, Holding "Drinatrans" AD, AD "Zvornik putevi", AD "Vitinka", , DOO "Studen-prom", DOO "Obuća", AD "Vodovod i komunalije", DOO "Zo-Ži" , etc. Zvornik has founded a Business Zone covering a surface area of 10 ha with a complete infrastructure, suitable for investment.

Zvornik has 6 primary schools with 4200 pupils, two secondary schools with 18000 students, and one higher education institution - The Faculty of Technology. There is also Helath Institution and General Hospital important for the whole region.

German NGO *GTZ* has pronounced the municipality of Zvornik the best municipality in Bosnia and Herzegovina with respect to the treatment of the young, and the European Movement in Bosnia and Herzegovina has awarded Zvornik with “European open area“ award.



# ALUMINA DOO

Alumina d.o.o. was released into operation on 6th October 1978 and in the period 1984-1989 has paid a special attention to a development of products in the area of aluminosilicate chemistry. During that period the company built



five plants which also rely on the company's infrastructure and its raw material resources. The company is supplied with all the necessary raw materials, i.e. bauxite, quartz sand and energy from its immediate surroundings. Alumina d.o.o. is the only company in the Western Balkans and the southeastern Europe which uses the Bayer process to produce alumina and different types of hydrates from bauxite. Bauxite, supplied from the local mines, is advantageous in terms of micro impurity and the content of organic compounds. Alumina d.o.o. is also recognized by a symbiosis of several types of productions. Apart from hydrates and different types of alumina, the company also produces different types of zeolites, sodium silicates and liquid "water glass", and all products are in accordance with ISO and REACH Standards. The company's position in the eastern part of the Republic of Srpska and Bosnia and Herzegovina allows an easy access to the ports on the Adriatic sea and the river Danube, and, consequently, to the large number of countries to which it exports, such as Spain, France, Italy, Germany, Denmark, Netherland, Switzerland, Austria, Slovenia, Slovakia, Macedonia, Hungary, Czech Republic, Romania, Bulgaria, Poland, Ukraine, Russia, Belarus, Croatia, Serbia, Montenegro, Greece, Turkey, Israel, Saudi Arabia, Jordan, Tunis, Egypt, Sudan, Morocco, Algeria, Pakistan, India, China, USA, Columbia, Costa Rica.

# ZEOCHEM DOO

Zeochem d.o.o. in Zvornik is a branch of a quality-oriented Swiss company with locations throughout the world. The company is a global market leader in complex industrial separation and purification processes. It makes molecular sieves that filter the impurities out of natural gas and bioethanol, and neutralize volatile organic compounds before they give off odors. The company creates the building blocks for OLEDs that conjure razor-sharp images on smart phones and TVs. Zeochem supports the pharmaceuticals industry and the production of insulin and many other medicines, and by concentrating medical oxygen it improves many people's quality of life. The employees are committed to their customers worldwide and work with them to develop innovative solutions, products and processes. In recent years, the company has grown from a niche supplier to a global market leader in silicate chemistry. They produce in China, in the USA, in Bosnia and Herzegovina, and in Switzerland, and they are constantly expanding. Zeochem, a manufacturer of high-quality molecular sieves, chromatography gels and deuterated compounds, was established more than 200 years ago. In 1818, the Schnorf brothers lay the foundation stone for the CPH group to which Zeochem belongs when they opened a chemical factory in Switzerland. Swiss DNA is still a key factor in the company's success, shaping its identity and determining its actions. As a leading company in the silicate chemistry field, they set trends and create added value for their customers. The company's R&D teams focus on new product development, existing product improvement and understanding how their products are used in the customers' applications. Zeochem offers support for its customers as a trusted advisor and partner throughout the life of the products. Zeochem is committed to customer-focused innovation. The company continually develops new products with optimum performance for existing and new applications – offering better service lifetimes with more efficient materials.

The logo for Zeochem, featuring the word "ZEOCHEM" in a bold, sans-serif font. The letter "O" is stylized with a red dot in the center. A registered trademark symbol (®) is located at the top right of the word.

# GOLD SPONSORS

## **ELIXIR ZORKA - MINERAL FERTILIZERS DOO**

Recognizing the importance of the production of mineral fertilizers, as well as the overall development potential of this branch of the chemical industry, Elixir Group privatized the factory Zorka Mineral fertilizers in the 2011. and incorporated it within its business system under the name Elixir Zorka. With an investment of 38.5 million euros, a new factory was built with the revitalization of all existing reservoirs for storing raw materials and associated infrastructure.



Elixir Zorka's production includes various formulations of complex mineral fertilizers of the highest quality, characterized by a high concentration of nutritive elements, uniform granulation and high water solubility in soil. These mineral fertilizers completely satisfy nutrient requirements of different crops, regardless of crop specificity, related production requirements and differences in soil quality. From the very beginning, Elixir Zorka has been devoting special attention to the needs of farmers, along with a deep knowledge of the market, and this is what distinguishes Elixir Zorka from the competition. Elixir Zorka's solutions and fertilizers are designed to improve plant nutrition, increase application efficiency and production profit, while on the other minimizing adverse environmental impacts.

As the leading producer of complex mineral fertilizers in Southeast Europe, Elixir Zorka produces and distributes over 350,000 tons of different formulations of NP, PK and NPK fertilizers annually.

Elixir Zorka is the absolute leader in the production and sales of complex fertilizers on the domestic market, with a market share of 50%. A large part of Elixir Zorka's products is distributed on the regional market and the strategic plan is to expand sales on the global market in the forthcoming period with aim to make brand Elixir Zorka globally recognizable by the top quality of our complex mineral fertilizers.

Elixir Zorka is focused on constant innovation and application of the latest technologies in the field of mineral fertilizers in order to provide high quality products to its customers. The next step towards this is the construction of a special plant for the production of special fertilizer formulations, which represents the innovation of the development team of expert Elixir Zorka. The key task of the development team is to create highly efficient solutions for farmers around the world, relying on deep knowledge of their requirements.

## GOLD SPONSORS



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## BACTERICIDAL EFFECTIVENESS OF ACTIVE CHLORINE SOLUTION WITH ESSENTIAL OILS

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### Abstract

Insufficient hygiene of food contact surfaces often leads to food contamination with bacteria that cause foodborne diseases in humans, which is a growing public health problem and causes large economic losses, despite modern improvements in food production and preservation techniques. The use of natural substances with antimicrobial activity, such as essential oils, is an environmentally friendly and effective way to control the presence of potentially pathogenic bacteria. These agents are increasingly used in combination with conventional antimicrobial agents. Therefore, the aim of this study was to examine the antimicrobial activity of essential oils namely *Lavandula officinalis* (lavender), *Melaleuca alternifolia* (tea tree), *Menthae piperitae* (mint) and *Rosmarinus officinalis* (rosemary), and active chlorine solution (0.1%) (Aqualor H1000, Sigma d.o.o., Crvenka) against two gram-positive bacteria *Bacillus cereus* ATCC 11778 and *Staphylococcus epidermidis* ATCC 12228, and two gram-negative bacteria *Pseudomonas aeruginosa* ATCC 10145 and *Salmonella Typhimurium* ATCC 14028, as well as to evaluate the antimicrobial activity of essential oils and active chlorine solution (0.1%) mixed in different combination (FIC) in order to detect synergistic or antagonistic effects and discuss these effects (FICI, FIC index) on the basis of an improved checkerboard technique. The results showed a synergistic and additive effect for most combinations of active chlorine solution and essential oils. While with the reference strain *P. aeruginosa* ATCC 10145, an indifferent effect was observed in the combination of active chlorine solution with essential oils of mint and rosemary. The effectiveness of the solution of active chlorine with essential oils was determined using the quantitative suspension test according to the DGHM method. The results indicated that the maximum germicidal effect of the solution was achieved after exposure for 5 minutes for all tested bacteria. The lowest degree of reduction was recorded against *B. cereus* ATCC 11778 and *S. Typhimurium* ATCC 14028 at the shortest exposure time of 1 minute, while a stronger effect was recorded against *S. epidermidis* ATCC 12228 and *P. aeruginosa* ATCC 10145. Taking into account that there has been an increased interest in the use of natural antimicrobial agents in recent years, the application of a combination of active chlorine with essential oils represents a significant strategy in the control of pathogenic bacteria.

**Key words:** bactericidal efficiency, active chlorine, essential oils.

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