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FACULTY OF  
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# XXIII

## INTERNATIONAL CONGRESS

# VII

ENGINEERING, ENVIRONMENT AND MATERIALS  
IN PROCESS INDUSTRY  
EEM2021

BOOK OF ABSTRACTS



JAHORINA  
MARCH 17-19, 2021

REPUBLIC OF SRPSKA  
BOSNIA AND HERZEGOVINA

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# **VII INTERNATIONAL CONGRESS**

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

***EEM2021***

**UNDER THE AUSPICES OF  
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AND  
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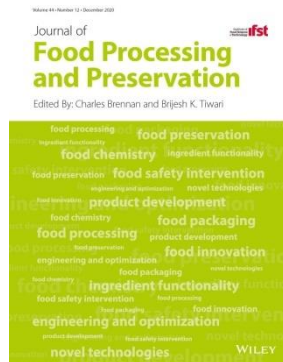


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## CITY OF ZVORNIK

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 Majeвица, 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 alumosilicate 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 as a circle with a small red dot in the center. A registered trademark symbol (®) is located at the top right of the word.

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## UPGRADING OF A FUEL POTENTIAL OF WASTE BIOMASS VIA HYDROTHERMAL CARBONIZATION

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### Abstract

*In recent decades, the massive exploitation of fossil fuels, with a detrimental impact on the environment, caused a growing demand for the production of energies from renewable sources. One of the researchers' solutions was the application of waste biomass, but there are many disadvantages of its direct utilization, that include high moisture content, low energy content, high volatiles content, etc. In order to overcome these disadvantages, attention has been focused toward development of technologies for conversion of biomass into a multi-functional products. Hydrothermal carbonization (HTC) has recognized as highly effective technology for production of carbon rich material, hydrochar, from wet and waste biomass. Hydrochar possess a great potential for application as an energy source, for environmental protection, in agriculture. In this paper, three selected biomasses (corn cob (CC), Paulownia leafs (PL) and olive pomace (OP)) were hydrothermally carbonized at different temperatures (180, 220 and 260°C). The main goal of this study was to examine the influence of temperature on the structure and fuel characteristics of the obtained products and to compare it with the precursor. The results showed that the solid yields decreases significantly with increasing temperature in all samples. On the other hand, C content increase upon temperature increment and reach the highest values in hydrochars obtained at 260°C (69.30% for CC, 64.54% for PL and 70.97% for OP). Also, a decrease in O/C and H/C atomic ratios with increasing temperature was observed. The results are shown in the Van Krevelen diagram, which reveals the transformation of precursors during carbonization from the biomass to the lignite region. Furthermore, with decrease of O/C and H/C ratio, higher heating value (HHV) was increasing and reaches the maximum values for hydrochars prepared at 260°C (27.33 MJ/kg for CC, 28.06 MJ/kg for PL and 30.55 MJ/kg for OP). The same trend is noticeable with ED contents. Also, the content of volatile matter (VM) was determined in all samples. VM decreases (from 90.45 to 55.42% for CC, from 76.70 to 62.10% for PL, from 82.86 to 66.77% for OP) with temperature contributes to less evaporation and pollutant emission during direct combustion. According to results, can be concluded that temperature has a great influence on the structure and characteristics of the obtained products, that dehydration and decarboxylation during HTC provoke intensive biomass carbonization and that hydrochars obtained at higher temperatures have significantly enhanced fuel properties and less volatiles compared to the biomass.*

**Key words:** hydrothermal carbonization, hydrochar, waste biomass, biofuel.