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49th International October Conference on Mining and Metallurgy

PROCEEDINGS

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Nada Štrbac
Ivana Marković
Ljubiša Balanović

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PREFACE

On behalf of the Organizing Committee, it is a great honor and pleasure to wish all the participants a warm welcome to the 49th International October Conference on Mining and Metallurgy (IOC 2017) held at Bor Lake, Serbia, 18 – 21 October 2017.

The IOC 2017 has been organized by the University of Belgrade, Technical Faculty in Bor, in cooperation with Mining and Metallurgy Institute Bor. It is devoted to presenting recent research results and advances in the fields of geology, mining, metallurgy, materials science, technology, environmental protection, and related engineering topics. The primary goal of IOC is to bring together academics, researchers, and industry engineers to exchange their experiences, expertise and ideas, and also to consider possibilities for collaborative research.

This year's conference is dedicated to the memory of Professor Dragana Zivkovic who was one of our most loyal and active Committee members. The 4th International Student Conference on Technical Sciences (ISC 2017) will take place within the frame of IOC 2017. ISC provides a unique opportunity for the students from both the country and the region to promote scientific research and discuss future directions of research with the experts and specialists.

These proceedings include 153 papers from authors coming from universities, research institutes and industries in 30 countries: Austria, Bosnia and Herzegovina, Bulgaria, China, Croatia, Czech Republic, France, Germany, Hungary, India, Iran, Italy, Japan, Jordan, Kazakhstan, Libya, Macedonia, México, Montenegro, Norway, Poland, Romania, Russia, Slovakia, Slovenia, South Africa, Spain, Turkey, USA and Serbia.

Financial assistance provided by the Ministry of Education, Science and Technological Development of the Republic of Serbia is gratefully acknowledged. The support of the sponsors and their willingness and ability to cooperate has been of great importance for the success of IOC 2017. The Organizing Committee would like to extend their appreciation and gratitude to all the sponsors and friends of the Conference for their donations and support.

We would like to thank all the authors who have contributed to these proceedings, and also to the members of the scientific and organizing committees, reviewers, speakers, chairpersons and all the Conference participants for their support to IOC 2017. Sincere thanks to all the people who have contributed to the successful organization of IOC 2017.

We look forward to welcoming you to the 50th International October Conference on Mining and Metallurgy (IOC 2018), which will be held in October 2018.

On behalf of the 49th IOC Organizing Committee,

Assistant Professor Ivana Marković, PhD

IN MEMORIAM

Prof. dr Dragana Živković
(13th September 1965 – 26th November 2016)

Dragana Živković, a full professor and the dean at the Technical Faculty in Bor, University of Belgrade and a full member of the Academy of Engineering Sciences of Serbia, gave an immeasurable contribution to the development of science and education in the fields of thermodynamics, metallurgical engineering and materials science. She left a deep trace, unique in its nature, not only in Serbia, but also in the world.

Dragana Živković was one of the leading scientists in the field of Thermodynamics of multicomponent metallic systems, Advanced metallic materials, Metallurgy of iron and steel, Kinetics of metallurgical processes and Archaeometallurgy. She published over 200 scientific papers in international SCI journals, over 150 papers in national journals and more than 500 conference papers. Her papers have been cited more than 500 times.

She was involved in about 40 projects, about half of them being international, many of which were coordinated by Dragana herself. She was a member of numerous international and national scientific and professional organizations and associations, the editor-in-chief of Journal of Mining and Metallurgy, Section B: Metallurgy, a member of editorial boards of several international and national journals, the secretary of the Committee of thermodynamics and phase diagrams of Serbia, and the chairman and a member of the scientific and organizing committees of numerous national and international scientific conferences.

Through her continual participation at the International October Conference on Mining and Metallurgy, as an author, as a member of the organizing committee and the president of the scientific committee on several occasions, she managed to make this conference distinguishable in wider scientific circles, connecting people through successful collaboration and lasting friendships.

She was our dear friend, a valued and generous colleague and an inspiring teacher. She touched all of us with her positive attitude, dedication, generosity and friendship.

For all of us who had the privilege to know her, she will always be the part of our lives.

The 49th IOC Organizing Committee

TABLE OF CONTENTS

Plenary Lectures

Section Lectures

Conference Papers

NEW DIRECTIONS OF THE APPLICATION OF MICRONIZING MINERAL RAW MATERIALS

Vladimir Nikolić[1], Milan Trumić[1], Maja Trumić[1], Dragan Radulović[2], Ljubiša Andrić[2]

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Abstract

The paper aims to show the wide application of micronized products that arise after micronization milling. Fine-tinted-micronized materials such as alumosilicates, lycones, non-metallic mineral raw materials, thanks to their physical-mechanical, physical and chemical properties (density, color, shape, reflection index, conductivity, size and structure of micro particles, etc.) production of modern new materials. They can be used as fillers, coatings, for dusting, used in processing, pharmaceutical and other industrial branches, and they are irreplaceable in the production and processing of many definite products. Micronized mineral resources represent a significant potential in remedying the harmful effects of environmental pollution, but also one of the crucial factors in preventing this same pollution.

***Keywords**: Micronization milling, mechanical activation, fillers*

1. INTRODUCTION

Changeable socio-economic conditions and requirements bring pressure to increase the intensive development of modern materials that are capable of sustaining extreme mechanical, thermal and electrical loads as are now required in new industrial technology-technical solutions. In particular, fine-tuned (micronized) mineral raw materials, which can be used as fillers for masses in the synthesis of new modern materials and as coatings. For these reasons micronized mineral raw materials must have strictly defined physical-mechanical, physical-chemical and mineralogical characteristics [1].

The modern industry imposes the need to achieve the best possible marketing of goods on the market, achieving as low a production price as possible and maximizing the quality of products, and thus towards the development of technological procedures. In the world and in our country more and more fillers are used for this purpose, which means minerals and synthetic materials that can fill in and replace to a certain degree expensive raw material in the product being produced, as well as contribute to its better qualities.

The choice of a mineral as a filler is influenced by economic factors and characteristic features that must be satisfied for the application in the appropriate industry. The main reason for the application of most of the micronized products (filler) is the lowering of the price of production, which is why the economic factors that influence the price of minerals are extremely important. These factors include the value of minerals and the distribution in nature and the accessibility of exploitation [2].

In addition to the crystalline and crystallochemical characteristics of minerals, fine micronization is a very important type of process of milling and construction of devices (micronizers) in which the process takes place. They use micronizers that work on the principle of impact, impact and friction, and so on. For all these possible effects, disintegrators, colloidal mills, roller-plate mills, planetary mills, ultra-centrifugal mills, jet-mills and others are used [1].

2. MICRONIZATION

Micronization milling is present in the development of modern technologies (ceramics, powder metallurgy, sintering, catalysis, etc.). However, micronization is often used in the pharmaceutical industry for the production of low-density drugs. In pharmaceutical products, the size of drug and component particles can affect processing and biological availability. These powder particles provide a higher rate of dissolution of the drug particles, for oral use. For pharmaceutical purposes, the particle size must be 1 to 10 micron. [3, 4].

Figure 1 - Pharmaceutical products obtained after micronization milling [5]

By the treatment of literature it can be noticed that there are a lot of papers and researches in the field of micronization milling, and short review of these works is given below.

Terzic and associates (2017) investigated the mechanochemical activation of bentonite clay in an ultra-centrifugal mill, in a time interval of 15 to 60 minutes. The micronic globular bentonite particles, produced by activation, improved the packing of the composite structure which resulted in a denser material with strong bonded componential grains [6].

Ilic and associates (2016) investigated the kaolin micronization in a conventional horizontal ball mill, where they micronized milling in a time interval of 30 minutes to 20 hours. The obtained milling product represents a new material with significantly altered surface of kaolinite, different cation exchange capacity, porosity and absorption capacity of water, reduced crystal size and a larger specific surface, and as such can be used in the cement based system [7].

Balczár et al. (2016) investigated the mechanochemical and thermal activation of kaolin in a planetary ball mill, and the time of micronization milling was in the interval from 15 to 300 minutes. The obtained milling product shows that mechanical-chemical activation is effective for the production of inorganic polymers (geopolymers) and kaolin takes up the part as a raw material [8].

Andric and associates (2013) investigated the micronization of mica in a planetary ball mill, in a time interval of 30 to 360 minutes. They have come to the conclusion that the obtained milling product can be used to produce powdered materials, and as a filler. It should be noted that micronized mica minerals have a specific application, such as capacitors, insulators, plastic fillers, pearl pigments, coatings, polymers, equipment and devices used in the aviation industry [9].

Figure 2 - General appearance of some mills used for micronization

Vieceli et al. (2017) examined the mechanical activation of lithium to improve the recovery of lithium concentrate from the ore of lepidolite. They micronized milling in a chrome steel disc mill at a time interval of 0 to 45 minutes. Lithium has a wide application, and is mostly used for batteries in mobile phones, laptops, electric and hybrid vehicles, and they can be added to glasses and ceramics to improve power and resistance to temperature changes [10].

Terzić and associates (2015) examined the effects of mechanical activation on the parameters of talc quality, which can be used in the production of ceramics. Micronization milling was carried out in an ultra-centrifugal mill. After a certain milling time, the tongue mechanically activated. Mechanical activation is often used in the direct improvement of talc properties, and the production of modern ceramics requires the use of compound materials with advanced properties, where the main requirement is to minimize the size of the grain [11].

Burris and Juenger (2016) investigated the micronization of zeolites in a gravity ball mill. The resulting micronization milling product could be used as an additional cementitious material [12].

Terzic and her associates (2017) investigated the mechanism of mechanical zeolite mechanics in an ultra-centrifugal mill, in a time interval of 15 to 60 minutes. The micronizing milling product would be used as an additive in construction composites [13].

This short research review points to the importance of micronization as a process for obtaining fillers for new materials.

3. CONCLUSION

This paper presents only a small part of the application of products that arise after micronization milling. Continuous development in industry and global society imposes increased demands for quality improvement, as well as increased production of micronized products. The main reason for the application of most micronized products is the lowering of the price of production, which is why the economic factors, which affect the price of minerals, are extremely important. Products of micronization milling have more and more space in the technological processes of all industries. However, the requirements of the technological processes of these products for the quality of products that arise after micronization milling are very strict. In the production of new materials, in which the micronized products enter, special attention must be paid to the fact that micronized milling products have strictly defined physical, chemical and mineralogical

characteristics. In order to obtain micronized products, and starting from the great demands of industry for such products, which have incomprehensible application as fillers, adsorbents can be realized in mills of modern construction (micronizers).

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