University of Belgrade
Technical Faculty in Bor,
Mining and Metallurgy
Institute Bor

54th International October Conference on Mining and Metallurgy

PROCEEDINGS

Editors:
Ljubiša Balanović
Dejan Tanikić

18-21 October 2023, Bor Lake, Serbia

PROCEEDINGS,

54th INTERNATIONAL OCTOBER CONFERNCE

on Mining and Metallurgy

Editors:

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University of Belgrade, Technical Faculty in Bor

Technical Editor:

M. Sc. Miljan Marković

University of Belgrade, Technical Faculty in Bor

Publisher: University of Belgrade, Technical Faculty in Bor

For the publisher: Dean Prof. dr Dejan Tanikić

Circulation: 200 copies

CIP - Каталогизација у публикацији Народна библиотека Србије, Београд

622(082)(0.034.2)
669(082)(0.034.2)

INTERNATIONAL October Conference on Mining and Metallurgy (54 ; 2023 ; Borsko jezero)
Proceedings [Elektronski izvor] / 54th International October Conference on Mining and Metallurgy - IOC 2023, 18-21 October 2023, Bor Lake, Serbia ; [organized by] University of Belgrade, Technical Faculty in Bor and Mining and Metallurgy Institute Bor ; editors Ljubiša Balanović, Dejan Tanikić. - Bor : University of Belgrade, Technical Faculty, 2023 (Niš : Grafika Galeb). - 1 USB fleš memorija ; 1 x 1 x 5 cm

Sistemski zahtevi: Nisu navedeni. - Nasl. sa naslovne strane dokumenta. - Tiraž 200. - Preface / Ljubiša Balanović. - Bibliografija uz svaki rad.

ISBN 978-86-6305-140-9

a) Рударство -- Зборници b) Металургија -- Зборници

COBISS.SR-ID 126659849

Bor Lake, Serbia, October 18-21, 2023

Conference is financially supported by
The Ministry of Science, Technological
Development and Inovation
of the Republic of Serbia

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PREFACE

On behalf of the Organizing Committee, it is a great honor and pleasure to welcome all esteemed participants of the 54th International October Conference on Mining and Metallurgy (IOC 2023), scheduled to take place at the picturesque Bor Lake, Serbia, from October18th to 21st 2023.

The collaborative efforts of the University of Belgrade, the Technical Faculty in Bor, and the Mining and Metallurgy Institute Bor have meticulously organized this year's IOC. Our focus remains unwavering on showcasing the latest research findings and advancements in geology, mining, metallurgy, materials science, technology, environmental protection, and other engineering disciplines. Our primary objective is to foster a dynamic environment where academics, researchers, and industry professionals can come together to share their knowledge, experiences, and innovative ideas while exploring opportunities for collaborative research endeavors.

Our conference agenda is rich and diverse, encompassing plenary sessions, engaging invited lectures, technical presentations, enlightening oral and poster sessions, informative technical tours, a diverse exhibition, and memorable social gatherings. At the heart of this event lies our strong commitment to sustainable development within the mining and metallurgy sector. We are dedicated to exploring ecologically conscious methodologies, responsible resource extraction practices, and cutting-edge technologies that reduce the industry's environmental impact and enhance the well-being of local communities.

The conference proceedings comprise 129 papers authored by individuals from universities, research institutes, and industries in 22 countries. We are proud to welcome participants from Bosnia and Herzegovina, Bulgaria, Canada, China, Croatia, Germany, Greece, India, Iran, Kazakhstan, Libya, North Macedonia, Montenegro, Morocco, Romania, Russia, Slovakia, South Africa, Spain, Turkey, United States, and, of course, Serbia.

We are excited to host the 8th International Student Conference on Technical Sciences (ISC 2023) as part of IOC 2023. This event offers students from Serbia and the wider region a unique chance to showcase their research and discuss the future of their fields with experts.

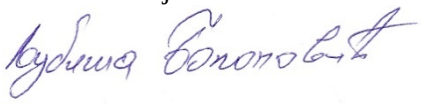
We sincerely thank the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia for their generous financial support. In addition, we express our profound gratitude to all our sponsors, exhibitors, and friends of the Conference for their contributions and unwavering support for playing a pivotal role in ensuring the success of IOC 2023.

We would like to express our heartfelt thanks to all authors, committees, reviewers, speakers, and chairpersons for their invaluable contributions in shaping IOC 2023.

We look forward to welcoming you to the 55th International October Conference on Mining and Metallurgy (IOC 2024), which will be held in October 2024.

On behalf of the 54th IOC Organizing Committee,

Prof. dr Ljubiša Balanović



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TAILING MANAGEMENT: TAILINGS FILTERING EQUIPMENT

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Abstract
The implementation of tailings dewatering technologies is essential in minimizing water losses and optimizing water recovery. This issue often has a significant impact on the decision-making process when choosing between high-density slurry, paste, and filtered tailings management approaches. The use of filtered tailings disposal has seen substantial growth in recent years, highlighting the crucial significance of filtering equipment in this process. In that regard, this paper briefly outlines the fundamental equipment used for tailings filtration.

***Keywords**: tailings, filtration, water, equipment*

1. INTRODUCTION

Managing mineral processing tailings and associated water has become increasingly challenging due to the growing tonnages of minerals processed annually [1]. The challenges associated with tailings storage are increasing. There are two crucial aspects that need to be addressed when it comes to dealing with the tailings from mineral processing plants. First, it is imperative to ensure secure and environmentally sound storage for the tailings. Additionally, it is equally vital to promote the sustainable utilization of water in this process [2]. The choice of the best tailings disposal method depends on several factors. These include the degree of pre-disposal dewatering, which is influenced by the rheology and transportability of the tailings. Furthermore, it is crucial to take into account the chemical and biological reactivity of the tailings, as well as the requirement for return water and the quality of process water for recycling. The site climatic conditions and the topography, the distance and elevation of the selected tailing site facilities relative to the plant impact the selection tailings disposal method as well [3]. There are various options available for disposing of mine tailings, including cross valley or hillside dams, raised embankments, dry stacking of thickened tailings on land, and backfilling into abandoned open pit mines or underground mines [1, 4]. A large number of mines worldwide still use conventional TSFs to disposal tailings. On the other hand, numerous mining companies are adopting a more innovative approach to managing tailings. As an alternative tailings disposal method stands paste disposal (high-density thickened tailings or paste tailings), either as surface deposition or underground backfilling [1, 5]. Using filtered tailings can offer substantial advantages and should be consistently regarded as a viable choice for constructing new tailings storage facilities [5]. In order to minimize water losses and decrease the demand for raw water in the processing plant, it is essential to thickening the tailings before disposal. This allows the possibility of recycling process water directly back into the plant. The tailings continuum simply depicts the nature and behavior of tailings at different thickening degree [6]. Figure 1 shows the tailings continuum concept [7,8].

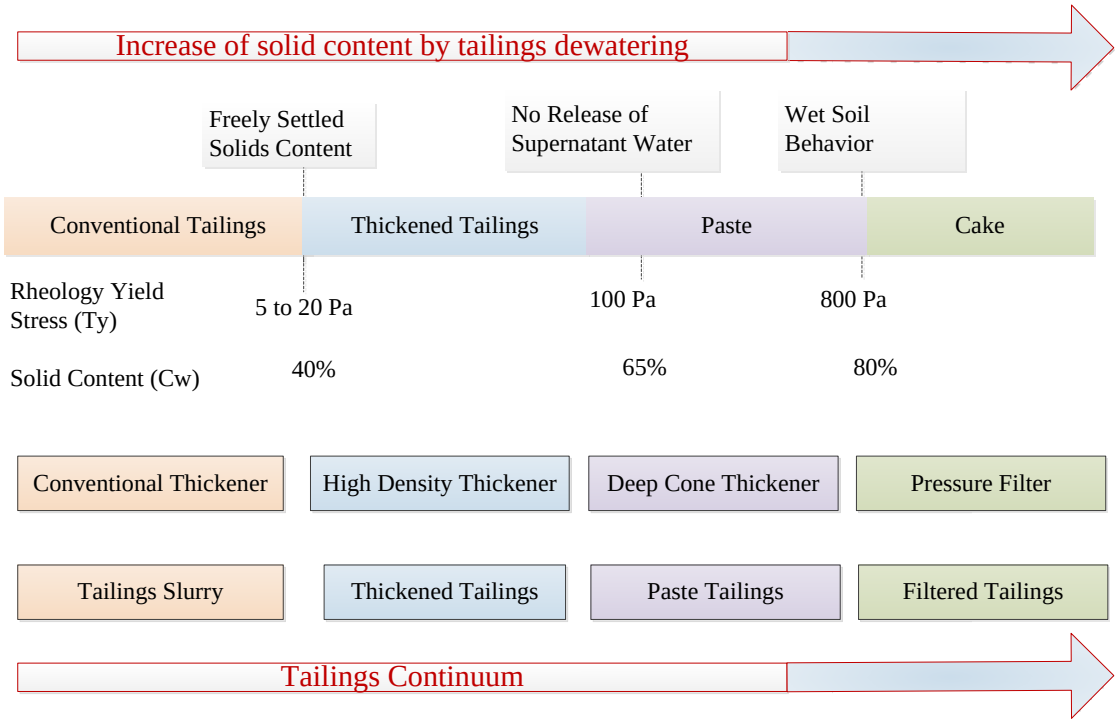

Figure 1 - Dewatering tailings technologies–tailings dewatering continuum [Adapted from Ref. 8]

Dry stack tailings, or filtered tailings, are an innovative and contemporary method for effectively managing tailings. Dry stack tailings, in contrast to traditional wet tailings stored in ponds with water, involve dewatering the tailings to remove excess moisture before methodically stacking them in a controlled manner. This leads to the creation of a stable stack of compact tailings, greatly reducing the persistent risk of tailings dam accidents that have plagued the mining industry for many years [9]. Achieving optimal performance from the thickener is crucial in order to maximize the effectiveness of the filtration equipment.

2. TAILINGS FILTERING EQUIPMENT

The nature of the tailings material is critical in the filtration process. High percentages of clay minerals adversely affect the filtration process. It is crucial to define the strength, moisture retention, and hydraulic conductivity of tailings, while considering the corresponding technology employed. The main goal should be to achieve a moisture content that facilitates construction while meeting slope stability requirements [9]. It is generally recommended to target a moisture content that is similar to the standard Proctor optimum moisture content [9].

Table 1 categorizes filtration techniques into two main processes: continuous and batch. In continuous processes, belts or drums are commonly used, while in batch processes, horizontal or vertical pressure filters with a membrane are often employed [10]. The dry matter content that can be obtained is highly dependent on the specific gravity of the material as well as other material characteristics. The numbers in the table 1 are therefore only indicative considering mining default values [10].

Table 1 – Considerations of Filtration Techniques [10]

Type	Process	Heavy duty	∗Max. solids content∗, %	Electricity consumption	Critical design parameters
Vacuum filtration					
Belt	Continuous	Yes	>75	High	Belt speed, Layer thickness
Disk	Continuous	Limited	>70		Rotation speed, Layer thickness
Drum	Continuous	Limited	>70		Rotation speed, Layer thickness
Pressure filtration					
Chamber	Batch	Yes	>75	Low	Cycle time, Dry matter content
Membrane	Batch	Yes	>85		Cycle time, Dry matter content
Belt	Continuous	Limited	>70		Belt speed, Layer thickness

∗ The dry matter content that can be obtained greatly relies on the specific gravity of the material, alongside other material characteristics. Considering default mining values, the numbers in Table 1 are merely indicative [10].

2.1 Vacuum Filters

In mineral applications, there are various configurations for vacuum filters, with disc and horizontal belts being the most prevalent ones. Smaller capacity underground backfilling operations often rely on disc filters. Horizontal belt filters are the most common type of vacuum filter used for surface disposal of large tailings throughput [11]. Horizontal belt filters are part of the vacuum filter family and are designed to receive the slurry to be filtered from the top. The Horizontal Vacuum Belt Filter (HVBF) uses filtering fabric as the filter medium, which utilizes the material gravity and vacuum suction to realize the separation of the solid and liquid. The Ceramic Disc Vacuum (CDVF) is an innovative and efficient solid-liquid separation device that emerged in the 1980s, providing remarkable effectiveness and energy conservation [12]. The ceramic filter has a shape and mechanism that closely resembles the working principle of the disc vacuum filter. A pressure difference is responsible for driving the flow of the suspension through the filter medium. This process ultimately results in the capture of particles on the medium's surface and the creation of a filter cake.

2.2 Pressure Filters

The Filter Press is an outstanding batch-processing pressure filter that offers remarkable separation efficiency and operates with a simple yet effective mechanism. Over the course of many years, numerous significant improvements have been made to the design of this extensively utilized processing equipment. Significant improvements have been made in automating cake discharge and filter media washing. Filter presses are preferred for dealing with cases where tailings have a fine particle size distribution and high throughput is required. In recent years, Diemme® Filtration has successfully developed and constructed an innovative and groundbreaking "next generation" of colossal filter presses [13]. These pioneering machines boast an impressive throughput capacity, approximately three times greater than the largest filter press currently being used in operation. The GHT5000F Domino stands out as the largest filter press on the market, with an impressive maximum total filtration volume of 71 m^3 and a maximum total filtration area of 2.850 m^2.

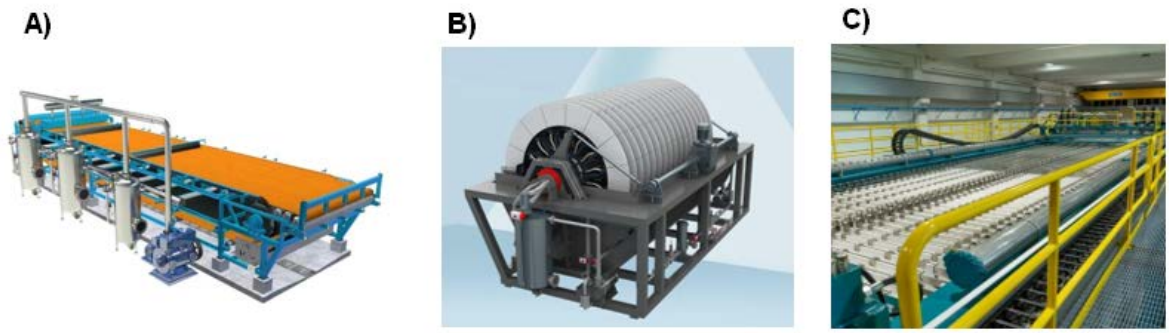

Figure 2 - Tailings filtering equipment (Horizontal Vacuum Belt Filter (A) [14], Ceramic Disk Vacuum Filter (B) [15] and Filter Press (C) [13]

3. CONCLUSION

The filtration and dry-stacking of tailings are rapidly gaining popularity as the most preferred method of tailings management. Additionally, the most commonly used dewatering technologies for the filtration of tailings from ore processing are rotary vacuum disc filters, filter presses and belt filters. This technology offers significant benefits that can greatly enhance any project over its lifetime. One of the key advantages is its ability to effectively reduce water supply costs.

ACKNOWLEDGEMENTS

The research presented in this paper was done with the financial support of the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, within the funding of the scientific research work at the Mining and Metallurgy Institute Bor, Grant No. 451-03-47/2023-01/200052.

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