MINING AND METALLURGY
INSTITUTE BOR

and

TEHNICAL FACULTY BOR,
UNIVERSITY OF BELGRADE

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International October Conference

55th International October Conference on Mining and Metallurgy

PROCEEDINGS

Editor:
Ana Kostov

15 – 17 October 2024
Hotel "Đerdap" Kladovo, Serbia

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RISKS AND PROTECTIVE MEASURES FOR MINING OPERATION WITH A BALL MILL

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Abstract

The employees and responsible persons in the mining industry are obliged to work with full attention for the safety of their lives and health as well as the lives and health of other employees, protection of mining facilities, work equipment and other material assets and to comply with the established safety and health measures at work. The employees and responsible persons who do not comply with the established measures of safety and health at work, fire protection and other measures within the mining operations, commit a serious violation of their work obligations. This paper presents the risks and protective measures, use and safe operation of a ball mill, used in the mining operation – grinding, without delay about any occurrence of danger during the performance of mining work, especially about the occurrence that may threaten the safety of employees, material goods and property and life and health of people.

***Keywords**: protective measures, mining, ball mill*

1. INTRODUCTION

Based on the Law on Mining and Geological Explorations ("Official Gazette of RS", No. 101/2015, 95/2018 – other law, and 40/2021) - Part VIII: Protective Measures; the Law on Safety and Health at Work ("Official Gazette of RS", No. 35/2023), the Rulebook on the Procedure for Inspection and Checking the Work Equipment and Testing the Working Environment Conditions ("Official Gazette of RS", No. 15/2023); and the Rulebook on Occupational Safety and Health in the Mining and Metallurgy Institute Bor; the instructions for handling, use and safe work with the mining equipment should be created.

In order to protect the life and health of employees, the organizations in the mining industry are obliged to: [1]

- Regulate the safety and health of employees at work, in accordance with the specifics and dangers that may arise,
- Organize the performance of safety and health at work, in accordance with the laws and regulations on safety and health at work,
- Provide the personal protective equipment and personal protective equipment for the employees,
- Provide the protection against fire, breakdowns, accidents, and chemical and other accidents and organize the rescue operations, and
- Organize the training of workers in the field of safety and health at work and rescue operations, in cases of a sudden danger to the life and health of people and

safety of facilities according to the established plan and program, throughout the year and to check the knowledge once a year.

It is necessary to create a manual for handling, use and safe operation for each device used in the mining industry,

This User Manual must contain the essential instructions for operation and maintenance of a device that must be strictly followed. It is essential that they are read by the operator and qualified personnel responsible for device before a device is ordered. This User Manual must be visible, legible and accessible at the place of use at all times.

The user of a device must confirm to the administrative operator (owner) that he has received the sufficient instructions on operation and maintenance of the device. The user has received the operating manual, read it, as well as all warnings related to it, and therefore has all the information necessary for safe operation and is sufficiently familiar with the device.

In this paper, the results of the risks and protective measures, use and safe operation of a ball mill used in the mining operations will be presented.

2. EXPERIMENTAL

Grinding is a technological operation for crushing the solid particles to the desired size. [2] It is the final stage of size reduction the mineral raw materials affected by the external mechanical forces. Reduction of coarseness by grinding is carried out to the limiting coarseness, required by the concentration process, or in the case when the raw material does not go into the concentration process to the coarseness required by the market.

The goal of comminution is to increase the specific surface area of the comminuted material. As a preparatory procedure, grinding, in addition to reducing the coarseness, always is aimed to release the useful mineral components from grain. Concerning this, a special set task is to ensure a satisfactory level of release, without causing the undesirable ore crushing.

Grinding is carried out in different types of mills, classified according to their characteristics (drum mills with balls or rods, autogenous mills, vibration mills, mills with rolling elements, colloid mills, etc.), and can work dry or wet (without or with addition of water). [3]

A ball mill TM 300 XL, the German company Retsch in the Mining and Metallurgy Institute Bor, consists of a rotating drum with balls inside. [4] The material to be ground is introduced into a drum through an axial part of the drum. When the ball drum rotates, due to the impact and friction, the material particles ground are crushed. The drum shell is made in the form of a sieve so that sufficiently finely divided particles pass through it. The ball mill operates continuously, and its particles of various materials can be crushed to very small dimensions.

3. RESULTS AND DISCUSSION

The ball mill TM 300 XL is successfully used in almost all areas of industry and researching. This particularly applies to high demands in terms of hygiene, speed, finesse and reproducibility.

Thanks to its robust design, the ball mill has proven particularly good in the mining industry, but also in the construction materials sector (cement), geology, mineralogy, metallurgy and power plants.

The earth, concrete, electronic components, ore, glass, ceramics, coal, coke, corundum, metal oxide, minerals, plant parts, slag, silicates, cement, cement clinker, and many other substances can be ground quickly and easily with this device.

The device advantages are as follows:

- powerful and fast grinding of large quantities,
- suitable for dry and wet grinding,
- variable speed, repeatable results,
- modules for ball mills and rod mills are available,
- simple tilting to rinse a mouth of the mill,
- convenient setting of parameters via display,
- separation grid for sample separation from the grinding balls,
- sanding of the seal with a protective cover for safe operation, and
- solid cover for noise protection.

The device is used for its intended purpose – milling and grinding. There are the following risks and protective measures:

1. ***Risk of the explosion or fire.*** During the grinding operation, the sample characteristics are changed. Considering the properties, and therefore the hazards of sample, it may be changed may during the grinding process. Any substances cannot be used in the ball mill that pose a risk of explosion or fire. Due to its design, the mill is not suitable for use in hazardous and potentially explosive atmospheres as well as it cannot be used in a hazardous atmosphere.

2. ***Risk of body injury.*** There is a danger from the sample nature. Depending on a hazardous nature of sample, an operator should take the necessary measures to exclude any danger to the persons who operate with the mill. It should be followed the safety guidelines and data sheets for the material samples.

3. Risk of the area of device use. The ball mill is a laboratory machine designed for 8-hour single-shift operation and researching. The ball must not be used as a production machine, nor it is intended for a continuous operation.

4. Risk of the grinding set wear and tear due to the insufficient filling volume. Increased wear or damage to the grinding kit is possible if the grinding mill is operated with insufficient fill volume. The grinding set must be filled to at least 40% of the nominal volume.

5. Risk of reduction the tool service life due to the abrasive material samples. The presence of abrasive composite materials during grinding can significantly reduce tool life. When grinding electronic waste, an operator should consider the properties of composite materials.

6. Risk of the loud noise while grinding with the possibility that the sound signals are not heard. During the grinding operation, the acoustic alarms and voice communication may not be heard. The operator must consider the volume of grinding noise in relation to the other acoustic signals in the work environment and should use the additional visual cues.

7. Risk of the possibility the mill continues to run. There is a significant risk of injury if the mill and associated parts run for a long time without braking. There is a measure of emergency unlocking. The operator will activate the emergency unlock only when the mill is completely turned off and disconnected from the power supply.

8. Risk of reduction the tool service life with the used abrasive material samples. The presence of abrasive composite materials during grinding can significantly reduce a tool life of the mill. When the electronic waste is grinding, the operator must consider the properties of composite materials.

9. Risk of burns due to a hot grinding bowl. Depending on the grinding process, the material is ground and consequently the grinding can become very hot. The operator should wear the appropriate protection such as the protective gloves whenever touch the grinding bowl, especially if it is hot.

10. Risk of a fatal electric shock. Electric shock can cause injuries in the form of burns and cardiac arrhythmia, respiratory or cardiac arrest. The blender must not be clean under running water. A cloth soaked in water should be used for cleaning. The power supply before cleaning the blender must be disconnected.

11. Risk of a high voltage through the capacitor discharge. Due to the discharge of capacitor on the frequency converter, the mill has voltage for up to 5 minutes after pulling out the plug. After removing the power cable, the operator should wait 5 minutes before opening the mill.

12. The ball mill must always be switched off and disconnected from the mains before any cleaning or servicing interventions.

According to the presented possible risks and protective measures, it is necessary:

- to apply the prescribed measures for the safe and healthy work,
- to use the means of work, chemicals and other substances,
- use the personal protective equipment correctly, handles it carefully and returns it neatly to the place intended for its storage,
- before starting work, inspect workplace, including the means of work which is used, as well as personal protective equipment, and report any deficiencies to the authorized person,
- before leaving, leave the workplace and work equipment in such a condition that they do not endanger the other employees.

4. CONCLUSION

Risks, especially operational risks, affect more systematic aspects of a process or operation. They are those risks that can be readily identified as having one or more types of impact and which affect an expected outcome. Different operations and their activity areas in mining will face any number of operational risks for grinding with ball mill. These types of risks are an integral and unavoidable component of business. A wide range of risk assessment approaches are available to the mining industry. It is important that the decision makers choose a risk assessment technique that is suited to their application and information needs.

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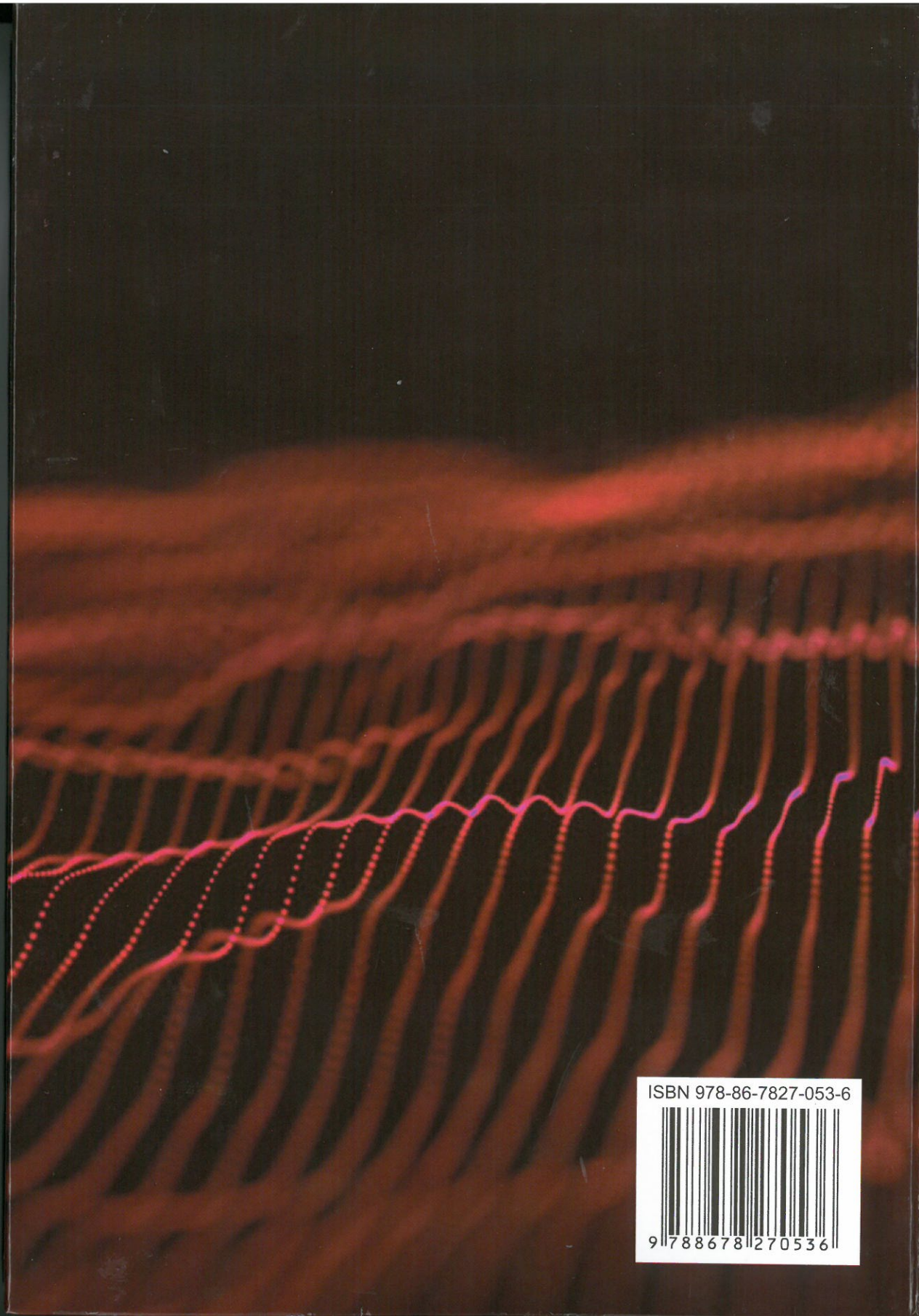
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