

**MINERAL ENRICHMENT AND PROCESSING: A GLIMPSE
INTO THE FUTURE**

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Minerals are the solid, liquid, and gaseous materials that are extracted from the interior of the earth for further use by humans. Solid minerals can be divided into two main categories: combustible and noncombustible. Non-combustible resources are in turn divided into agronomic resources, non-metallic resources and metallic resources.

The efficiency of extraction of a particular mineral depends largely on the content of a useful element in it and the presence of harmful impurities. Products obtained from mineral raw materials are processed by metallurgical, chemical and other methods only if their quality meets the established requirements for the necessary raw materials.

Beneficiation refers to any procedure that enhances the economic value of ore by eliminating gangue materials, leading to a higher-grade product and a waste byproduct. There are various forms of beneficiation, and each stage increases the concentration of the original ore. A crucial aspect of this process is recovery, which is defined as the mass or molar fraction of the valuable mineral or metal that is extracted from the ore and transferred to the concentrate [1].

Some ores occur in nature as mixtures of discrete mineral particles, such as gold in gravel beds and streams and diamonds in mines. These mixtures require little or no crushing, since the valuables are recoverable using other techniques.

Most ores, however, are made up of hard, tough rock masses that must be crushed before the valuable minerals can be released. Crushing and grinding are methods used to diminish the size of mineral fragments by applying external forces to break them apart. Essentially, these two processes are similar in nature. Generally, crushing is associated with generating larger particles, typically over 5 mm in size, while grinding

yields smaller particles, usually less than 5 mm. Crushers are utilized for the crushing process, whereas mills are employed for grinding.

The grain size to which the source material must be crushed or ground before beneficiation is determined by the size of the phenocrysts of useful minerals and the process adopted for beneficiation of the mineral.

The required grain size is determined experimentally through enrichment studies of each mineral.

The grinding of minerals is carried out in mills. They are divided into mechanical and aerodynamic.

The industry's future: a) Eco-friendly Technology (creating processes aimed at lowering carbon emissions and reducing environmental effects); b) innovation and research (allocating funds for research to discover new methods of enrichment and processing).

It should be noted that the processes of mining and mineral processing represent a complex, multi-stage system aimed at enhancing the economic value of natural resources.

Effective mineral processing, including methods such as beneficiation and mineral dressing, not only allows for the extraction of valuable components from ore but also minimizes environmental impact and optimizes production costs.

It is essential to consider both useful and harmful impurities, as they play a crucial role in determining the quality of the final product [2].

In the future, sustainable development in the sector can be achieved through the implementation of eco-friendly technologies and ongoing research aimed at improving enrichment and processing methods.

Thus, sound resource management and innovative approaches will help ensure economic efficiency while protecting the environment in the processes related to the extraction and processing of minerals.

References

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