

Evaluating the Potential of Microwave Treatment as a Rock Pre-Conditioning Method in Achieving a More Sustainable Mining

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Abstract : Mining Engineering, as a part of geoscience, must address modern concerns. Traditional mining methods incorporate drill and blast technologies, which are followed by different issues, including excessive noise, vibration, air pollution, and safety hazards. Over the past two decades, mining engineers have sought alternative solutions to move from drill and blast to continuous methods to prevent such issues and improve sustainability in mining. Among the suggested methods, microwave treatment has shown promising results by creating micro/macro cracks in the rock structure prior to the operations. This research utilizes an energy-based analysis methodology to evaluate the efficiency of the microwave treatment in improving mining operations. The data analysis shows that increasing the input microwave energy dosage intensifies the rock damage. However, this approach can decrease the energy efficiency of the method by more than 50% in some cases. In this study, rock samples were treated with three power levels (3 kW, 7 kW, and 12 kW) and two energy dosages (20 kWh/t and 50 kWh/t), resulting in six conditions. To evaluate the impact of microwave treatment on the geomechanical behavior of the rocks, Unconfined Compressive Strength (UCS) tests were conducted on the microwave-treated samples, yielding stress-strain curves. Using the stress-strain curves, the effect of the different powers and energy dosages of microwave are discussed. The energy efficiency calculated for this method in this study is more than twice the values published in previous literature. This research shows the potential of using microwave treatment to lead the industry to more sustainable mining.

Keywords : microwave treatment, microwave energy dosage, sustainable mining, rock fragmentation

Conference Title : ICGE 2025 : International Conference on Geological Engineering

Conference Location : Lisbon, Portugal

Conference Dates : February 08-09, 2025