

MANAGEMENT AND CONTROL OF UNDERGROUND MINE DILUTION: CURRENT TRENDS AND THE ROLE OF MACHINE LEARNING

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Dilution is a persistent challenge in underground mining that greatly impacts the economic and operational performance of the projects. The estimation and control of dilution are important aspects required to optimize the ore recovery and minimize the waste extraction, but there are major factors that arise during the mining operation such as geological complexities, lacking mining practices, and operational constraints. Some of the most prominent techniques used to address dilution include careful stope design, drilling and blasting optimization, the use of selective mining approaches, adequate support design, grade control techniques, and the implementation of real-time monitoring and control systems. These techniques can reduce dilution and improve ore recuperation, but the effectiveness can vary greatly depending on specific on-site conditions, and they rely on experience and empirical observations. In recent years the use of machine learning and advanced data analytics have enabled the extraction of major insights from large datasets (geological, production, monitoring, drilling, and blasting data), gaining notoriety for analysing and predicting dilution. Several studies have shown applications of machine learning in estimating dilution, optimizing stope design, and identifying dilution sources, and the current trends in dilution management have seen an increase in the integration of machine learning techniques, offering promising opportunities for addressing some of the major challenges. By using the power of data analytics and advanced algorithms, machine learning can improve the control and management of dilution in underground mining operations, leading to more sustainable mining practices.