

Effect of water flow rate on abrasive particle acceleration in rock excavation using abrasive waterjet

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ABSTRACT

Urban overpopulation has increased the demand for underground space development, yet conventional excavation methods often cause noise and vibration, limiting their use in urban areas. Abrasive Waterjet (AWJ) excavation has emerged as a low-noise, low-vibration alternative suitable for such environments. For effective field application, economic optimization is essential, particularly focusing on the acceleration of abrasive particles, which determines excavation efficiency. This study presents a numerical analysis investigating how pump pressure and orifice diameter, which control water flow rate, influence the acceleration and terminal velocity of abrasive particles. Results show that water flow rate significantly affects particle acceleration, and optimal combinations of pump pressure and orifice diameter were identified to enhance excavation performance while minimizing cost. These findings offer practical guidance for the efficient and economical application of AWJ technology in urban underground rock excavation.

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