Application and Optimization of Blasting Parameters in Selected Rock Quarries of Southwest and Northcentral Nigeria

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Blasting operations in the Auchi, Igarra, Okene, and Lokoja mineral districts of southwest and northcentral Nigeria frequently encounter challenges associated with poor rock fragmentation. Boulders ranging from 1 to 2 meters in diameter are common, often requiring costly re-blasting to reduce them to manageable sizes for crushing. Field investigations across eight mining pits revealed that quarries often utilize excessively high benches relative to the blasthole diameters employed, resulting in burdens that cannot be effectively fragmented. Moreover, there is a general absence of properly calculated burden, spacing, and charge quantities for each blasthole, as well as inadequate firing sequences. To address these issues, rock samples were collected from each pit and subjected to compressive strength analysis to determine the mechanical properties required for optimized blasting design. The predominant rock types identified include granite, marble, gneiss, and migmatite. The compressive strength of the granites ranged from 23 MPa to 26 MPa (class factor 5), while that of the marbles varied from 16 MPa to 20 MPa (rock factor 7). Blasthole diameters observed ranged between 40 mm and 80 mm, with bench heights from 10 m to 18 m. Analytical results suggest that the maximum recommended bench height for an 80 mm diameter blasthole is 7.2 m in granite and 11.2 m in marble quarries. Based on these findings, we propose appropriate bench heights, burden, spacing, and charge quantities tailored to each blasthole size and rock type. Additionally, a trapezoidal firing sequence is recommended to improve blast efficiency by promoting better fragmentation, enhancing material heaping for efficient loading, and minimizing the risk of fly-rock. The adoption of these optimized parameters is expected to reduce operational costs, enhance productivity, and ensure safer blasting practices across quarries in these regions.