ABSTRACT

Blasting is one of the most economical methods used for fragmenting rock mass. However, rock blasting causes a number of nuisances, such as ground vibration, air overpressure, fly rock, dust etc. It is consequential to state that merely 20-30 % of the explosive energy is used to fragment and displace the rock mass, while the rest is dissipated in the form of ground vibration, air blast, noise, and fly-rocks, etc. Further the impact of efficacy is also assessed by evaluation of powder factor. The powder factor impacts secondary breakage and the diggability of the excavators. The thrust area of the research has been to identify the blasting design and explosive parameters affecting peak particle velocity and powder factor for controlling the blasting nuisances. Many studies have been conducted earlier using only a limited number of controllable blast design parameters affecting peak particle velocity and powder Factor. However, only a limited number of studies have been carried out including a host of significant controllable blast design parameters.

In light of this, the present work contributes by developing a model using principal component analysis and step-wise selection and elimination statistical technique. The developed equation is validated within the statistical domain and the verified by employing multi-layer perceptron (artificial neural network) technique.

To comply with the objectives of research work, the sites for experimental blasts were selected considering almost similar geo-mining conditions. A total of 285 number of blasts (from three quarries) were recorded. Accordingly, the complete dataset comprising of 97 blast round in quarry ‘A’, 88 blast round in quarry ‘B’ and 100 blast round in quarry ‘C’ were produced for analysis. All the datasets recorded in terms of blasting design parameters and subsequently, the value of peak particle velocity is recorded and the value of powder factor were measured. In all the quarries, the 75% of datasets were used for development of the model and 25% were used for the validation of the developed model.

Further, to develop the statistical models in the form of equation for powder factor and peak

particle velocity, principal component analysis and stepwise selection and elimination followed by multi-variate linear regression technique have been used. The developed equations have been validated on another dataset and further verification has been carried out.

On validation within the statistical domain, for peak particle velocity and powder factor in all the quarries, the predicted values of peak particle velocity and powder factor are lying closer to the measured values. But, the values predicted by principal component analysis reveals the most accurate values of peak particle velocity and powder factor in comparison to stepwise selection and elimination and square root equation (in case of peak particle velocity only).

Apart from the statistical domain, Multilayer Perceptron (ANN) technique has also been used to verify the equation developed by both principal component analysis and stepwise selection and elimination tools and also to determine the correlation between the blasting design parameters with peak particle velocity and powder factor. It is found that the value of R^2 derived by artificial neural network is much higher than the values of R^2 derived by both principal component analysis and stepwise selection and elimination. This indicates that the accuracy of artificial neural network in predicting peak particle velocity and powder factor is very much satisfactory in comparison to principal component analysis and stepwise selection and elimination, and doubly validate the authenticity of equation developed by principal component analysis and stepwise selection and elimination in predicting the peak particle velocity and powder factor. However, principal component analysis and stepwise selection and elimination have also indicated excellent value of R^2 vis-à-vis better authenticity of the model to predict both peak particle velocity and powder factor.