

Multivariate analysis of blasting cost at Deewan Cement Quarry, Hattar: application of principal component analysis

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Economics of any cement quarry operation is mainly determined by the parameters of a process which minimizes the overall cost per ton of the rock mined during blasting. Blasting is only the first step in the production process for mines and quarries and the cost of this first step is normally 8% to 12% of the total costs. Hence, reduced blasting cost is one of the main objectives of production blasting at a cement quarry.

Due to multivariate nature of blasting operation and complexity of interaction among the parameters, it is not easy to control each and every parameter that results in the blasting cost. Hence a data reduction technique is needed to identify the most significant parameters that greatly influence the blasting cost. This paper presents the application of Principal Component Analysis on a dataset from one of the existing cement quarry operations located in the north of Pakistan. A total of 31 Nos. of blasts were studied and analyzed. The data has been taken from different benches of the same quarry and consists of many variables including No. of holes, bench height, sub-drilling, burden, spacing, burden to spacing ratio, No. of blasting rows, powder factor, quantity of bottom charge, quantity of column charge, and stemming etc.

The dataset was analyzed using principal component analysis (PCA) to identify the most significant parameters. These parameters were then subsequently used to formulate a model for the prediction of blasting cost per ton in the cement quarry operations. The prediction model was statistically significant and explains 88.1% of the variance in the blasting cost per ton. A comparison between the measured cost per ton and the predicted cost per ton based on the reduced data set has been shown to evaluate the effectiveness of data reduction using PCA.