Discussion by R.R. MacLachlan*

The Estimation of Fragmentation in Blast Muckpiles by Means of Standard Photographs, by H. van Aswegen and C.V.B. Cunningham. *Journal of the South African Institute of Mining and Metallurgy,* vol. 86, no. 12. pp. 469–474. Dec. 1986.

We have recently read the above paper and wish to make a number of observations.

The subject of blast fragmentation and its integration into mining operations is one of interest at McGill. We have also used a photographic technique to evaluate the fragmentation composition of a muckpile, based upon 35 mm photography[1].

The primary objective of these trials was to determine the quantities of oversize present. For this purpose, 8 blends of various known ratios of coarse, intermediate, and fine crushed rock (2,54 cm, 1,27 cm, and fines, totalling 0,14 m^3 each) were prepared. The samples were then subjected to a series of photographs, first as a simulated bench heap, and then as a partially excavated heap, as a conical pile built up incrementally, and as an apron dump or tallus fan. In all cases, the photographs were taken perpendicular to the fragmental slope and contained two spheres used as reference dimensions. These were placed in an upper and lower portion of the slope to reduce errors of perspective.

All the photographs were enlarged and marked off with a grid. Fragments within a grid cell were measured and recorded with a digitizer, while various numbers of cells were used for detailed measurements over increasing percentages of the fragmental slope.

From studies of the photographs, it was found that a very good determination of the quantities of oversize, intermediate, and fine material present in the test blend could be made when a minimum of 25 per cent of the slope exposure of the muck heap was examined.

Based upon our experience and a careful reading of the Van Aswegen and Cunningham paper, we wish to advance some commentary.

Firstly, the assembly of standardized model muckpiles based upon the equation for the Rosin–Rammler size-distribution curve,

$$R = 100 \exp - (x/x_c)^n,$$

using a reference characteristic size x_c and a range of values for the exponent n from 0,5 to 2,0 in increments of 0,25, is commendable. The major advantage derived from this is noted to be the visual appreciation of a gradation in the muckpile texture corresponding to the x_c, n sieved assembly of the reference sample.

Some weaknesses in the matching of a field photograph with photographs of the file blend references are inherent in the procedures as described in the paper under discussion.

(i) The determination of the field fragmentation is related to the choice of a suitable n index value. Apparently only one field photograph is taken containing the 275 mm diameter ball. If several such photographs were taken as a sampling of the muckpile surface, then a more reliable value of the n index value could be expected.

(ii) An oversight, resulting in significant error, occurs in the worked example in which the field and file photographs are matched.

Following the selection of the file photograph of index n = 1,25 and the reference enlargement with the black image measuring 4 mm as the best match to the field photograph, the mean field fragment size was derived by the multiple 4 mm × 32,35 (i.e. 4 mm × the ratio of the ball size to its image size). The multiple should have been 7,5 mm as listed in Table I, the mean fragment size, and used as the dimension for the black image square in the file of reference photographs.

The significance of individual oversize fragments in a muckpile, and the difficulty of determining their presence with accuracy, are well appreciated.

One may note briefly here that blast fragmentation is a two-component phenomenon[2]. It is dependent upon (a) the response of the ground blasted, including its physical and structural characteristics, and (b) upon the blasting procedure applied, including site geometry, drill pattern, explosives used, firing sequence, etc.

Comminution equations, historically derived from processing systems, are essentially descriptive of a single influence (the machine action) upon the observed fragment size distribution being described. Frequently, however, in blasting operations, the influences of ground response upon the fragment sizes present are not only apparent, but also aberrant to the degree of blast fragmentation desired. This is true to excess fines in some cases, and to excess oversize in others.

Care should therefore be exercised in using comminution equations, or modifications of them in 'predicting' blast fragmentation. The various comminution equations can provide a useful reference in the evaluation of blasting practice. However, the character of ground response involved must be appreciated if, indeed, the predictive mode is to be used with discretion.

References

1. SINGH, A. Photographic evaluation of blast fragmentation. M.Sc. thesis, McGill University (Canada), 1983.
2. MACLACHLAN, R.R., and SCOBLE, M.J. Techniques for the evaluation of rock mass structure in blast design. *Proceedings of the Second Mini-Symposium on Explosives and Blasting Research.* Society of Explosives Engineers, Atlanta (Georgia), Feb. 1986. pp. 132 – 144.

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