Prediction and Measurement of Blast Induced Rock Fragmentation-A Case Study of Kajiado County Quarries-Kenya

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Introduction

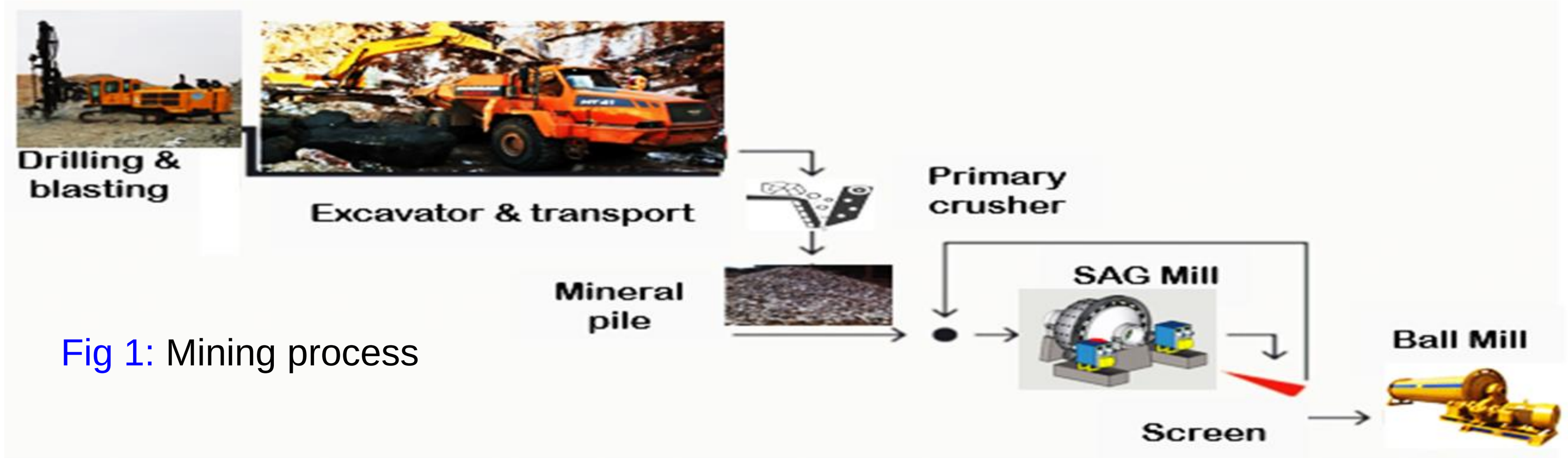

Fig 1: Mining process

A reliable rock fragmentation prediction model is an essential aspect of the blasting operation for improved production. Blasting affect all the downstream operations, including loading, hauling, and processing, there is a need for blasts to be designed in conjunction with fragment sizes modelling.

Methodology

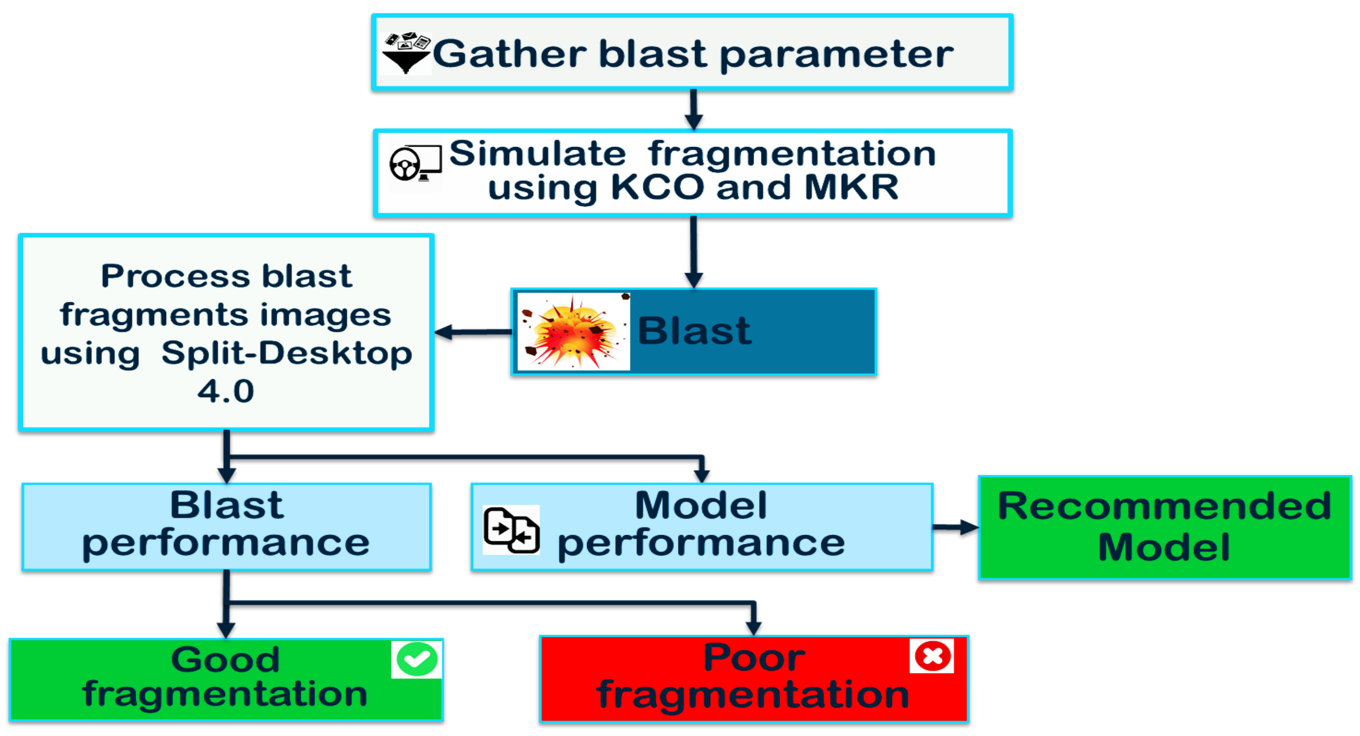

Fig 2: Research methodology; The data gathered was used to predict blast fragmentation using the selected models. This was to determine pre-blast particle size distribution at the sites. After collecting the bench data, a blast was done and images of the fragments taken for analysis using Split-Desktop. The process was repeated for six blasts considered for each quarry.

Data Collection`

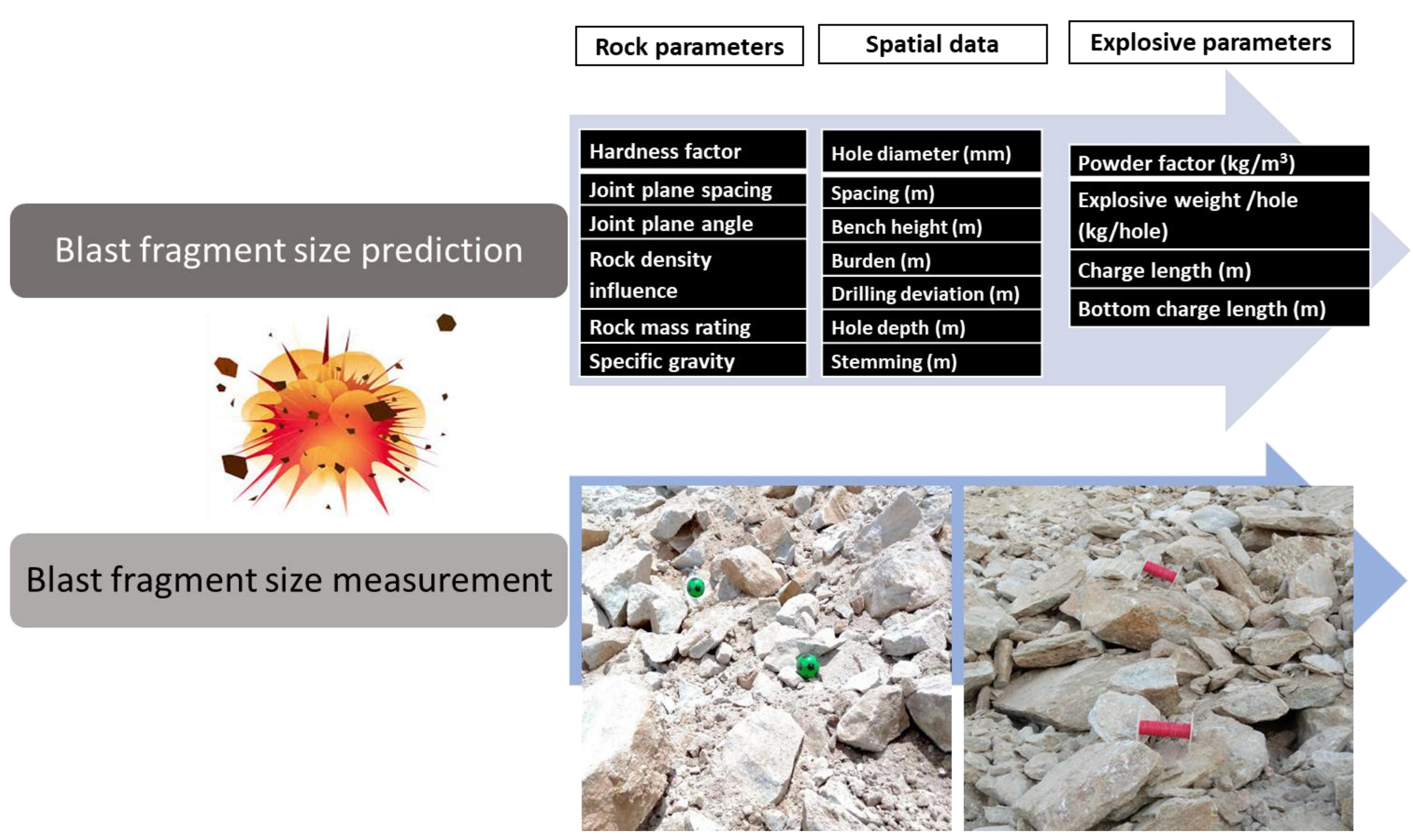

Fig 3: Data collection process. The blast fragment size prediction data was collected prior to blasting through field measurements while the blast size measurement was done by taking images of blasted rock materials

Data Analysis

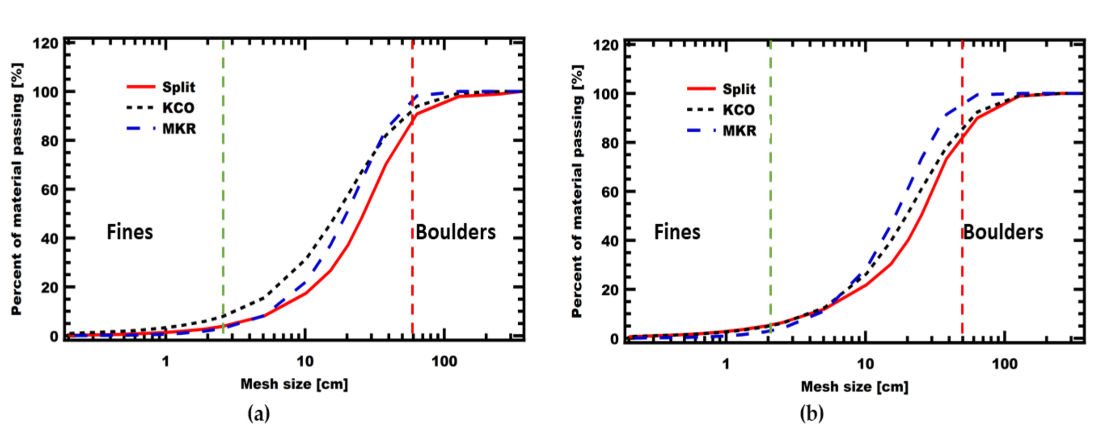

Fig. 4: (a) Blast 1 (b) Blast 2 fragment size prediction and measurement curves for Bissil quarry.

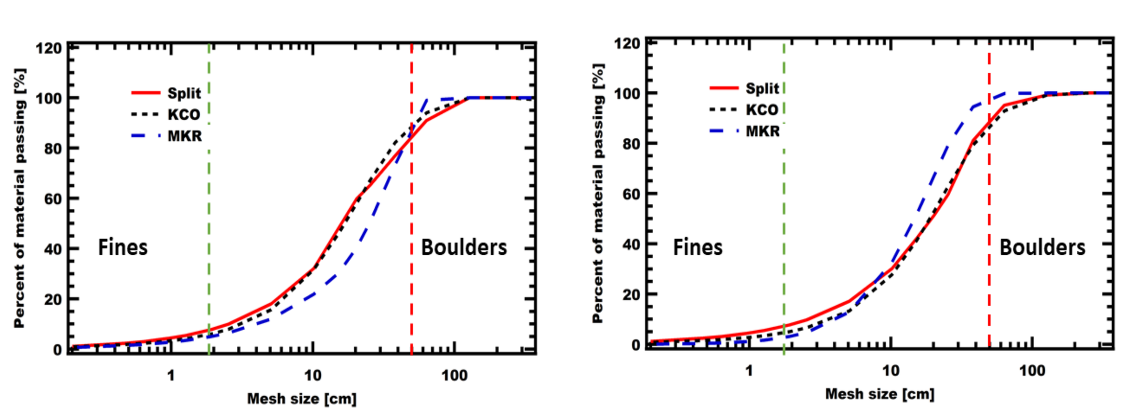

Fig. 5: (a) Blast 3 (b) Blast 4 fragment size prediction and measurement curves for Simba quarry.

Data Analysis

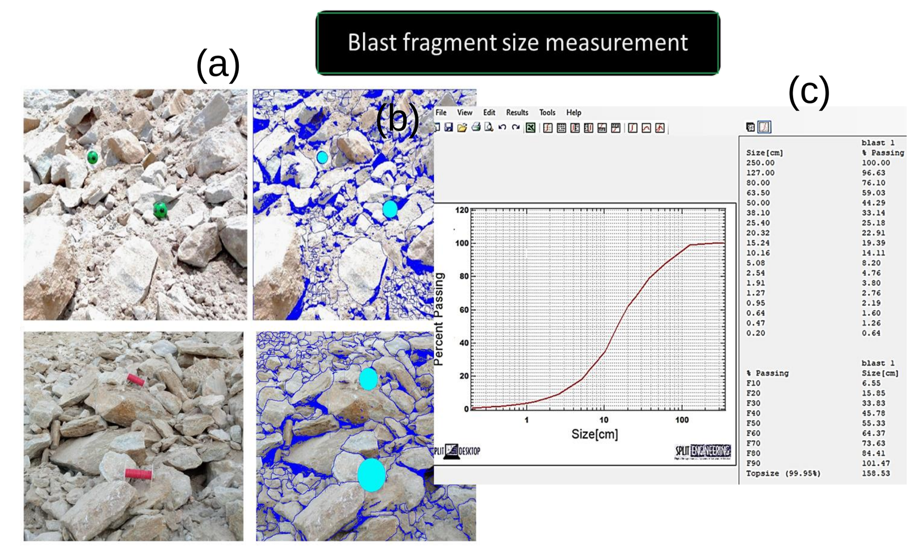

Fig 6: (a) Blasted rock taken from both Simba and Bissel quarries with scale object in place and (b) delineated image obtained using Split Desktop 4.1 (c) Split Desktop output

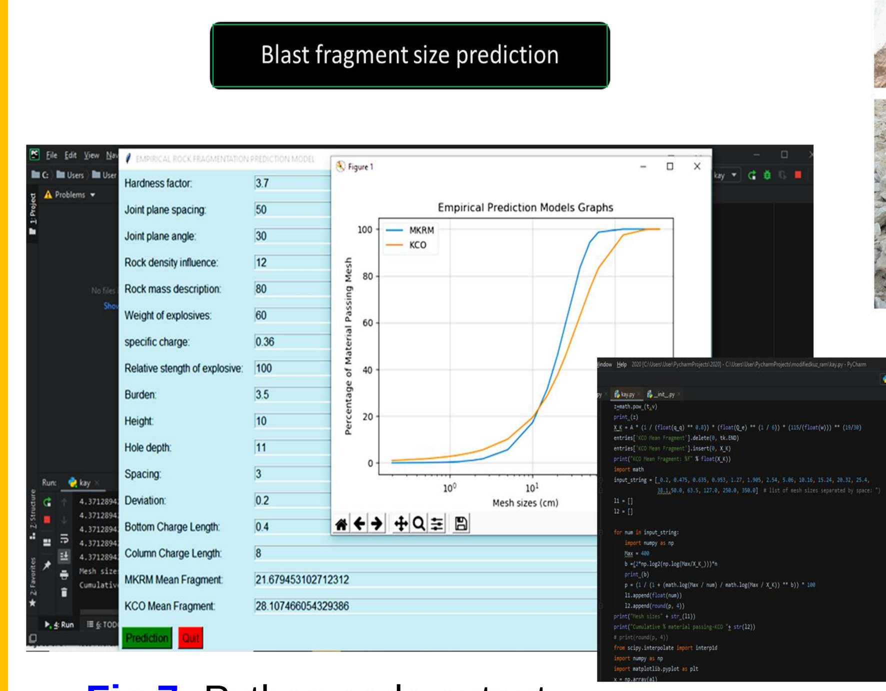

Fig 7: Python code output

Results

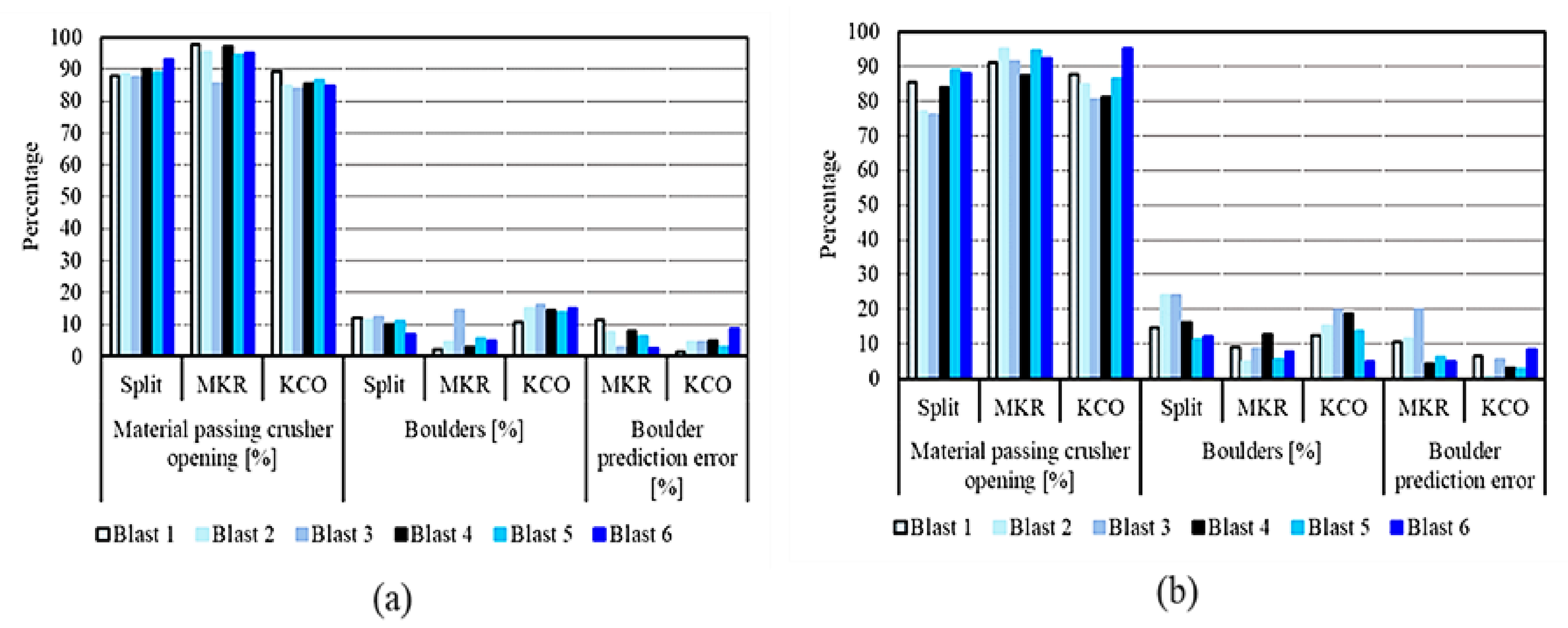

Fig 8: (a) Simba and (b) Bissel quarries material passing through crusher opening, boulder produced measurement and prediction analysis. It can be noted that KCO graph almost resemble Split graph unlike MKR graph. KCO also has the least error margin

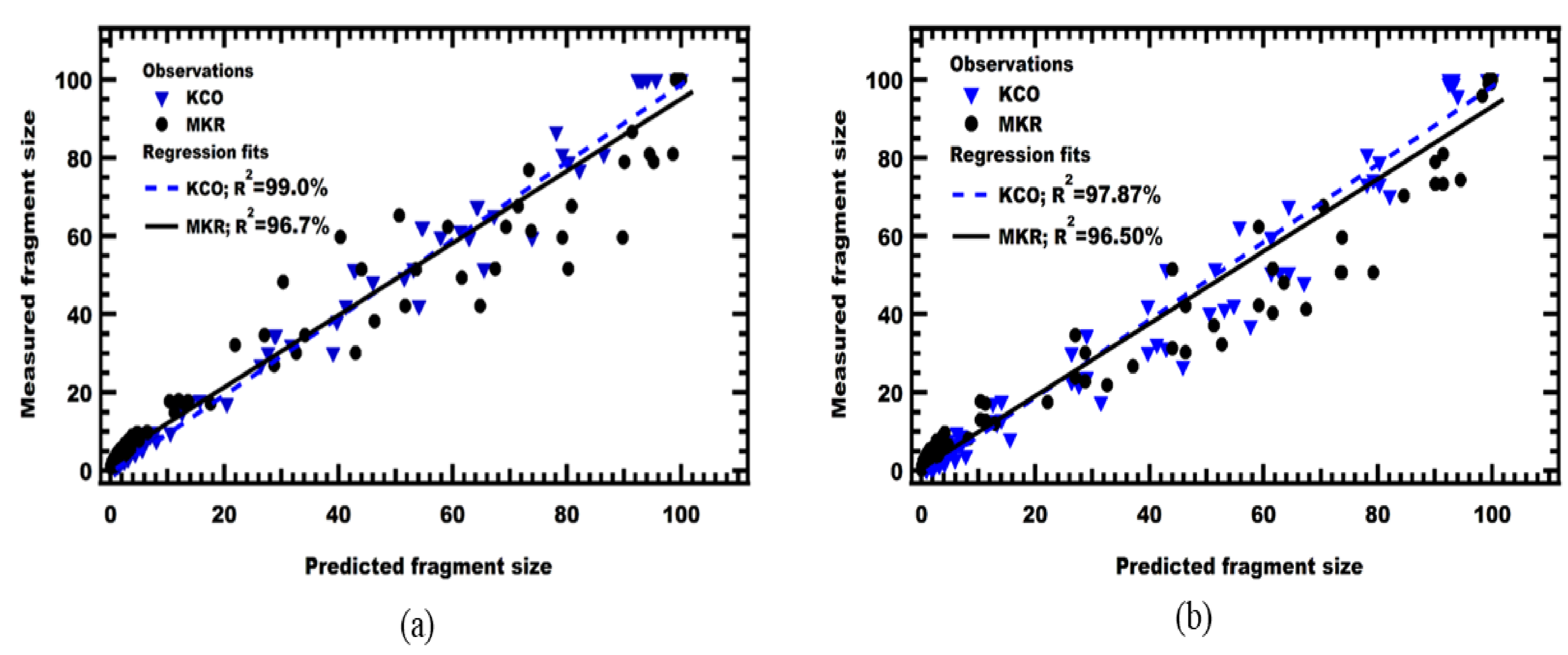

Fig 9: Regression graphs for (a) Bissel and (b) Simba quarries. KCO has higher R^2 value at 97.87% and 99.08% compared to MKR at 96.50% and 96.74% for both quarries respectively.

Conclusion

1. KCO was identified to have a better performance for both boulders and overall particle size predictions compared to the Modified Kuz-Ram.
2. Both MKR and KCO models provided a reliable guide on the expected blast fragment particle size distribution depending on the geology and blast design applied.
3. They can therefore help guide miners when evaluating various blast designs, investigating the impact of changing blast variables, and predicting the particle size distribution to be produced by each blast design applied.

Acknowledgement

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References

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2. Ouchterlony, F. and Sanchidrián, J. A. (2019) 'A review of development of better prediction equations for blast fragmentation', Journal of Rock Mechanics and Geotechnical Engineering. Elsevier Ltd, 11(5), pp. 1094–1109. doi: 10.1016/j.jrmge.2019.03.001.