Selective Calibrating Phosphatic Ore Resource Models to Mill Feedstock Head Grade Accurately Using Machine Learning

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Machine learning can create value in the mining industry by allowing multiple data types, of varying dataset size and granularity, interact with each other to calibrate a resource model prediction to mill processing measurements. The authors will introduce attention-learning neural network modelling, chosen features considered and included, and results of mill calibrating phosphate grade predictions to measured sorted feed via intermediary steps like cleaning and sorting. The authors present the results of this mill calibration technique in the Al Khabra area, an Arqah Phosporite member in northern region of the Kingdom of Saudi Arabia. The authors demonstrate how statistically significant non-linear correlated features, like segregation rate history, sand concentration, lithologies for ore and waste, seam number, etc. are used as inputs for models. Limited feature selection is crucial to ensure no overfitting. The predictions calibrated for this asset are phosphate (P2O5), silicon oxide (SiO2), and calcium (CaO). The ground truth was 10 months of monthly head grade measurements. The benchmark to improve against was the Kriging model's grade predictions for the aforementioned minerals. The results are the following: 1) for P2O5, there was 39% less monthly deviation, 2) for SiO2, there was 64% less monthly deviation, and 3) for CaO, there was 36% less monthly reduction. The results demonstrate that machine learning-based calibration techniques, especially non-linear methods, are more accurate in predicting mill outputs over the existing methods (where multiple intermediary steps introduce error). Suggested improvements for mill calibration include visual logging and improving sampling techniques at the crusher level.