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Cluster Analysis and Benchmarking for Performance Optimization of a Pyrochlore Processing Unit

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Abstract : Given the frequent variation of mineral properties throughout the Araxá pyrochlore deposit, even if a good homogenization work has been carried out before feeding the processing plants, an operation with quality and performance's high variety standard is expected. These results could be improved and standardized if the blend composition parameters that most influence the processing route are determined, and then the types of raw materials are grouped by them, finally presenting a great reference with operational settings for each group. Associating the physical and chemical parameters of a unit operation through benchmarking or even an optimal reference of metallurgical recovery and product quality reflects in the reduction of the production costs, optimization of the mineral resource, and guarantee of greater stability in the subsequent processes of the production chain that uses the mineral of interest. Conducting a comprehensive exploratory data analysis to identify which characteristics of the ore are most relevant to the process route, associated with the use of Machine Learning algorithms for grouping the raw material (ore) and associating these with reference variables in the process' benchmark is a reasonable alternative for the standardization and improvement of mineral processing units. Clustering methods through Decision Tree and K-Means were employed, associated with algorithms based on the theory of benchmarking, with criteria defined by the process team in order to reference the best adjustments for processing the ore piles of each cluster. A clean user interface was created to obtain the outputs of the created algorithm. The results were measured through the average time of adjustment and stabilization of the process after a new pile of homogenized ore enters the plant, as well as the average time needed to achieve the best processing result. Direct gains from the metallurgical recovery of the process were also measured. The results were promising, with a reduction in the adjustment time and stabilization when starting the processing of a new ore pile, as well as reaching the benchmark. Also noteworthy are the gains in metallurgical recovery, which reflect a significant saving in ore consumption and a consequent reduction in production costs, hence a more rational use of the tailings dams and life optimization of the mineral deposit.

Keywords : mineral clustering, machine learning, process optimization, pyrochlore processing
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