Improving the Sustainability of Copper Mining Through XRF Sensing, Machine Learning, and Bulk Ore Sorting

Hannah Lang, Karim Halaseh, Giovanni Pamparana
MineSense Technologies Ltd., Vancouver, BC, Canada

MineSense Technology equips shovels and belts with XRF sensors to enable bulk ore sorting at the mine face and process optimization within the mill. Machine learning is applied to the XRF data to classify the material in every bucket during extraction and along the belt in the grinding circuit. Simple algorithms convert individual peaks from the XRF spectra into element grades to recover ore from being sent to the waste piles and tailings and reduce the amount of barren material the mill processes. This is achieved through direct integration with the fleet management system so that trucks can be automatically routed to the correct destination as soon as the truck is filled. More advanced machine learning models are applied to the entire XRF spectra to classify ore material by intrinsic rock properties such as mineral speciation and to predict rock response properties of the material during processing, such as grindability. These methods can also be applied to quantify the acid-generating potential of waste material. The high-resolution data sets generated by MineSense's ShovelSense© and BeltSense© technology allow for smart mining decisions to be made to optimize the entire mine-to-mill pipeline, ultimately allowing mines to reduce the environmental footprint per unit of metal produced. A calculation of pre- and post-adaption of MineSense allows for the environmental impact to be quantified by measuring the ore recovery and dilution reduction enabled by bulk ore sorting at the mine face and calculating reductions in GHG emission and water, energy, and reagent consumption achieved through improvements in recovery. MineSense is deployed globally in over a dozen copper mines throughout North and South America. Here we present real data use cases and their implications for sustainable mining practices applied to the copper mining industry.