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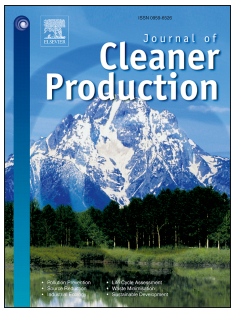

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G. Pamparana, W. Kracht, J. Haas, G. Díaz-Ferrán, R. Palma-Behnke, R. Román

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Integrating photovoltaic solar energy and a battery energy storage system to operate a semi-autogenous grinding mill

G. Pamparana[a,b], W. Kracht[a,b,*], J. Haas[c,d], G. Díaz-Ferrán[c,e], R. Palma-Behnke[c,f], R. Román[c,e]

[a]*Department of Mining Engineering, Universidad de Chile, Chile*
[b]*Advanced Mining Technology Center, AMTC, Universidad de Chile, Chile*
[c]*Energy Center, Universidad de Chile, Chile*
[d]*Department of Stochastic Simulation and Safety Research for Hydrosystems (IWS/SC Simtech), University of Stuttgart, Germany*
[e]*Department of Mechanical Engineering, Universidad de Chile, Chile*
[f]*Department of Electrical Engineering, Universidad de Chile, Chile*

Abstract

The mining sector in Chile is facing a steady increase of energy consumption, which is mainly explained by the lower grades, the increase in rock hardness, and deeper mines. Although much of the mining activity in Chile is located in the Atacama Desert, where the solar radiation is high, the integration of solar energy in mining remains elusive. This work explores, through simulation, the use of a solar photovoltaic energy system (PV) and a battery energy storage system (BESS), combined with energy from the grid, to operate a semi-autogenous grinding mill (SAG). For this, a novel mixed-integer linear programming model was developed to optimize the operational costs of the joint SAG-PV-BESS operation, after which the best sizes of PV and BESS components are found through scenario inspection. Further, the implementation of a demand side management (DSM) option is considered by a proper sequencing of the SAG feed to make a more efficient use of the solar energy. The results show an interdependent behavior of the SAG-PV-BESS system and a strong influence of DSM. The use of both PV and BESS allows reducing the contracted power for the SAG, without incurring into overconsumption penalties. If DSM is implemented, the system allocates the higher consumption, associated to harder ore, during daytime to use the available PV energy. Overall, the combined effect of PV and BESS operation of SAG mills allows reducing the energy-associated operational costs. This effect is exacerbated when DSM is implemented.

Keywords: Sustainable mining, Solar energy, Battery energy storage system, Semi-autogenous grinding mill, Demand side management

*Corresponding author at: Advanced Mining Technology Center, Universidad de Chile.
Email address: wkracht@ing.uchile.cl (W. Kracht)