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Hybrid Machine Learning and Fundamental Modeling for Real-Time Optimization of a Fluidized Bed Roaster

Junho Park[1], Joseph Lyman[1], Mark Darby[2], Luiz Lima[3], Chris Nelson[4] and John D. Hedengren[1], (1)Chemical Engineering, Brigham Young University, Provo, UT, (2)CMiD Solutions, Houston, TX, (3)Optima Powerware, Inc., Salt Lake City, UT, (4)Barrick Goldstrike Mines,Inc., Elko, NV

Abstract Text:

The advantage of hybrid modeling for the advanced process control (APC) applications is emphasized in [1] with advantages that utilize the strengths of physics-based [2] and data-informed modeling [3]. The hybrid approach uses ‘*a priori*‘ knowledge in the form of a nonlinear physics-based model with empirical model elements in a framework with several different methods and applications [4-7].

In the current study, a similar approach is used with process operation data from a fluidized bed roaster for gold ore processing. A certain type of gold ore, so-called refractory carbonaceous ore, contains naturally occurring carbonaceous material that harmfully affects the cyanidation gold recovery process by encapsulating the solubilized gold in it. The main purpose of the roaster is to oxidize these carbonaceous materials.

The reaction kinetics of the fluidized bed reactor is modeled with a shrinking core model (SCM) in conjunction with the heat and material balance equations. The unknown parameters in the model are effective diffusivity, particle size, and heat transfer coefficients that are empirically estimated with operation data.

The hybrid physics and machine learning model is used in a real-time optimization (RTO) application that sends target operating ranges to a model predictive controller (MPC). The RTO hybrid model demonstrates higher accuracy over traditional physics-based or empirical neural net approaches.

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Session Selection:
Big Data Analytics and Fundamental Modeling